WARTIME MILITARY ROENTGENOLOGY[1]

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IN TIMES of peace, an alert army prepares for the possibilities of war. This is especially true as far as the "combatant forces" are concerned. The duties of the Medical Department are more varied and much of our time is consumed with strictly professional work. In this, our interests and activities have been similar to those of our confreres in civil practice. We have relied upon conventional methods and accepted hospital procedures, using standard items of equipment and depending upon commercial supplies and installations in much the usual manner.

In these days, however, it behooves us to give serious thought to the types of medical activity required for expansion of our army to four, five, or possibly even greater multiples of its "normal" peacetime strength and then to adjust and readjust continually so as to be able to coördinate our services and activities with the rapid changes which may be expected. We must consider working conditions under heavy aerial attack as well as those produced by the rapidity of movement of motorized units. We can no longer depend upon plans made on the basis of

trenches and "pill boxes" and slow moving fronts as in the last Great War.

Radiologically, great strides have been made during the past twenty-two years. Our science became generally appreciated during the war years 1914 to 1918. Since that time our leaders have pointed out to us very tangible criteria which to-day substantiate our diagnoses to a reasonably accurate degree. We have become used to shock-proof performance, high milliamperage, and elaborate equipment. Yet, for field activities, we must yield to some extent to the requirements of quick disassemblage of our apparatus and provide for its easy portability. Thus, there are presented indications for new planning and new designing.

A discussion of this planning resolves itself into two phases: roentgen requirements near home communities and roentgen requirements in the theatre of operations.

ROENTGEN REQUIREMENTS NEAR HOME COMMUNITIES

One might boldly assert that it is only during the last five years that doctors everywhere have come to recognize roentgenography as the most trustworthy method of studying the chest. True enough, there were certain pioneers, such as Sawyer (11), who as far back as 1923

"seriously questioned. . . the efficiency of the stethoscope" and expressed doubts regarding the prevalent opinion that, "as compared with the physical examination, the roentgenological examination, even when done by experts, occupies a place of secondary importance in the diagnosis of tuberculosis of clinical significance."

On July 23, 1940, the committee on tuberculosis, of the Division of Medical Sciences of the National Research Council, in considering the matter of large-scale examination as planned for expansion of the U. S. Army (9), recommended that a chest x-ray film be made of each registrant, *supplemented* by physical examination and laboratory study as indicated. This recommendation, the committee explained, was based upon the following facts:

"(1) At least 75 per cent of early active tuberculosis can be discovered only by x-ray examination.

"(2) About 1.0 per cent of the male population of military age has active tuberculosis, most of which can be detected only by x-ray examination.

"(3) A high proportion of cases of early tuberculosis, detectable only by x-ray examination, are likely to break down under such strain as that entailed by military duty, incapacitating them for further service and making them a menace through contagion to their comrades.

"(4) X-ray examination is more expeditious than physical examination, thereby saving considerable time in the general examination.

"(5) X-ray film examination furnishes a permanent and authoritative record which may be useful in subsequent medico-legal adjustment.

"(6) Other conditions than tuberculosis which would make the registrant unfit for military duty may be discovered by x-ray examination.

"This procedure will amply repay the cost by saving of effective military man power, and reducing the ultimate cost to the Federal Government in pensions."

Spillman (12) estimates that "tuberculosis during and after the World War has cost approximately $960,000,000 to date in compensation, vocation training, insurance, and hospitalization," and that within the next five years these costs will pass the billion dollar mark.

The Medical Department of the U. S. Army is planning, in so far as possible, to include roentgen studies in the physical examination both at the time the recruit is examined for admission to the service, or shortly thereafter, and again just before discharge from the service becomes effective. It is planned that most of the roentgen studies of the chest will be done by photoroentgenography, using 4 × 10-inch films (two exposures), checking doubtful cases by the standard 14 × 17 inch roentgenograms. Time does not permit a detailed discussion as to why this particular method was adopted. Suffice it to say that all known possibilities of accomplishing the desired result have been analyzed in terms of relative merits as regards: (1) diagnostic reliability, (2) speed of examination, (3) preservation of records, (4) initial cost, (5) unit cost, (6) availability of supplies, and (7) ease of study. With reference to the first of these considerations, it seems only proper to quote Potter, Douglas and Birkelo (10), who state that "the 4 × 5 inch photoroentgenograph is quite accurate. (Only 2.6 per cent error in detecting 271 cases with active tuberculous lesions as found in the full size film taken of 1,610 persons.)" Similar expressions by de Abreu (2), Lindberg (7, 8), Hirsch (4), and others are no doubt well known.

It is anticipated that the chest studies will be one of the first steps in the examination of the candidate and that by the time he reaches the chest examiner, a report of the roentgen study will be available. In this way, the actual physical examination of the chest will be expedited, for the examiner will be given a lead as to whether he should concentrate on the heart or the lungs and, in the case of the latter, on which part. Where photoroentgenographic equipment is provided, two exposures rather than one are planned for each applicant, as this appears preferable and the additional cost is slight. At first, it is planned to use two positions. One exposure will be made with the chin raised and the scapulae rotated laterally and

forward, the candidate standing in front of the fluoroscopic screen in the conventional manner, as when 14 × 17 inch films are used. The second exposure will be made with the clavicles raised by elevating the upper extremities. It is anticipated that this procedure will be changed to the extent of making a true stereoscopic pair (providing for shifting of the x-ray tube) as soon as equipment is available for proper and rapid viewing of the miniature films and then, possibly, utilizing 35-mm. films as well. The objectives are more than merely to provide for depth perception. Consideration is also given to the increased accuracy of interpretation provided by true stereoscopic projections because of (1) the separation of parenchymal densities from overlying soft-tissue densities, such as the cardiac silhouette and diaphragm, and from osseous densities such as the ribs and spine; (2) the distinguishing of peribronchial irregularities which may be due to involuntary movements of the pulmonary vessels, from actual changes in the lymphatics or fibrous tissues; (3) control against deceptive artefacts which may occur either because of transient changes in radiographic performance or improper handling of the films. Particular attention will be given to the apices and the infraclavicular regions, and for these portions of the chest we believe that either the two-position technic or the stereoscopic pair will so add to the procedure that we may expect our diagnostic accuracy to reach, if not to exceed, that which would be obtainable with a single 14 × 17 inch film. At the same time, the unit cost will be much reduced, comparatively, and we shall have actual lifetime graphic records, of dimensions which will permit filing with the other records of the individual. The use of 14 × 17 inch film would require separate filing, with the probable result that the films would be stored in one part of the country while the remaining records were filed in another, thus defeating the object of comparative studies. For the same reason, fluoroscopy has not been considered practical. Fluoroscopy, moreover, could hardly be given a comparable degree of diagnostic trust (3), particularly as the roentgenologist would have to view from 200 to 400 or more candidates in a day.

The photoroentgen studies, as well as other roentgen studies (as requested), will be conducted at the army examining boards, of which it is anticipated there will be approximately one hundred scattered throughout the United States. An examining team will consist of approximately twelve officers, and it is anticipated that each team will be able to examine at least 200 men in an eight-hour day. A radiological group will include one roentgenologist and five to seven technicians. The equipment will consist of a high milliamperage capacity unit (200 ma. or higher), an adjustable tube column, a cassette changer, a photoroentgenographic unit (for many of the installations), and provisions for film-processing. Much of this apparatus is already available, in suitably situated army posts. Most additional purchases will provide actual war reserves of materials which may later be used in general hospitals.

ROENTGEN REQUIREMENTS IN THE THEATRE OF OPERATIONS

The front five to seven miles in a theatre of operations will be manned by troops of the divisional units. With these units there will be two types of medical troops: the so-called "attached medical troops" and those of the "medical battalion" (in the case of the stream-lined or triangular divisions) or the "medical regiment" (in the case of the square type of division). The attached medical troops will serve with the combatant troops, as in the last Great War, and will move along with their respective units, getting out onto the battleground, if necessary, to recover casualties and carry them back to "battalion aid stations." Beginning with the battalion aid stations, the personnel of the "medical battalion" or the "medical regiment" will take over the care of such casualties. It is not within the province of

this paper to discuss the various activities which will be conducted in the several installations of the medical battalion or regiment except to say that after emergency dressings, tourniquet applications, or splintings at the battalion aid stations, the wounded men will be evacuated as quickly as possible to "collecting stations" and from thence to "clearing stations," comparable to the "hospital stations" of

service fit into the general scheme. It does not seem practical to plan on any x-ray activities for the divisional area. X-ray personnel are not included with the attached medical troops, nor with the medical battalion or medical regiment. The most advanced installation in which x-ray services will be available is the mobile surgical hospital, which, as just mentioned, will be located in the vicinity
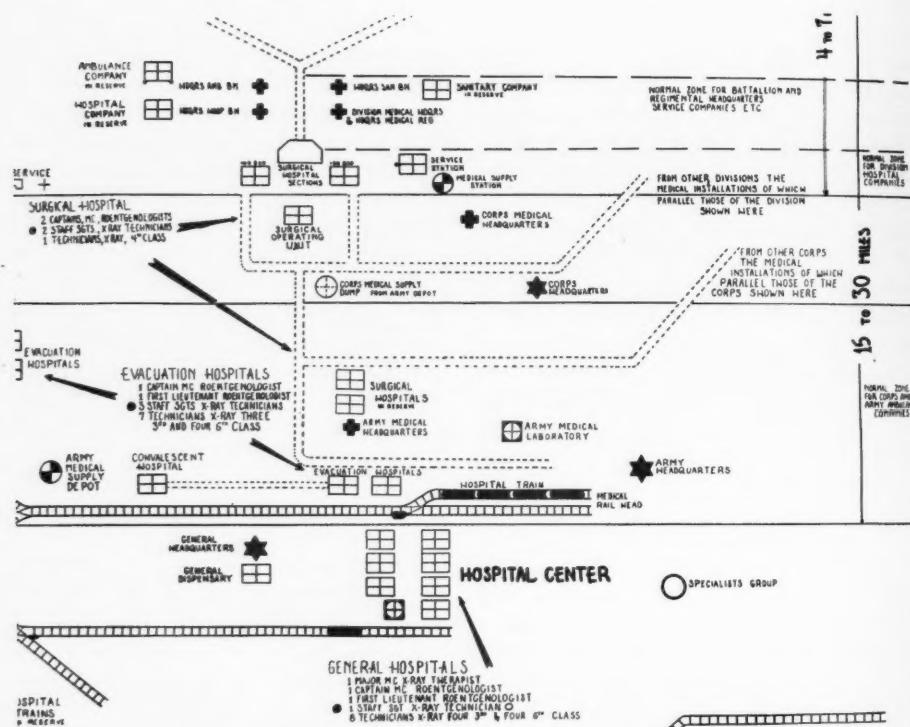

Fig. 1.   Showing the relative positions of the three important installations in the theatre of operations where radiological activities will be provided for front line casualties.

the last war. There, the "non-evacuables" will be selected and turned over to the care of the "mobile surgical hospital." Those who are in condition to stand further evacuation will be transported by ambulances of corps troops, to an "evacuation hospital."

These details are presented merely to indicate in a general way just where the personnel and equipment of the x-ray

of the "clearing station" of the medical battalion (or hospital station in the case of the medical regiment);   that is, approximately five to seven miles to the rear of the front lines. The mobile surgical hospital is an army unit which moves forward, as needed, into the zone of communications, particularly into a position near a clearing station.   The accompanying diagram (Fig. 1) shows these

relations and lists the x-ray personnel of this installation as well as of other installations engaged in roentgen activities further to the rear.

The Mobile Surgical Hospital.—The mobile surgical hospital is composed of two sections: a mobile operating unit and a hospitalization unit. The former, especially, can be quickly moved, as its important components are motor units (op-

genologists and three x-ray technicians are included in the personnel of the mobile surgical hospital. As in the last Great War, it is believed that most of the x-ray activities here will be fluoroscopic, including localization of foreign bodies. For general fluoroscopy, our equipment provides for considerable movement of the x-ray tube. Not only will horizontal fluoroscopy be easily managed, but in
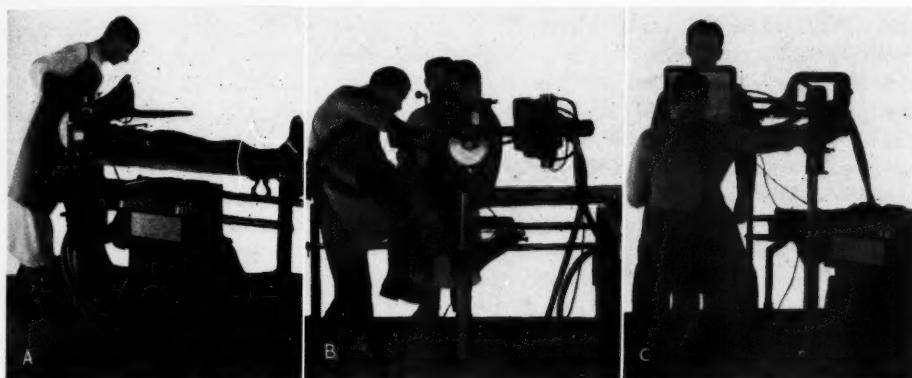

Fig. 2. The fluoroscopic adaptations of the x-ray table unit. Figure *A* shows the position of the C-shaped member for horizontal fluoroscopy and for foreign body localizations. Note the depth scale and skin marker manipulated by the left hand of the operator. The localization scale is in its position, fixed on the operator's end of the horizontal carriage. Figure *B* shows the adaptation of the C-shaped member for sitting fluoroscopy. A spacer falls into position to indicate the minimal focal-skin distance (12 inches). Figure *C* shows the adaptation of the C-shaped member for standing fluoroscopy. The range of movement provides for studies both of the chest and the abdomen.

erating, x-ray, sterilization, and supply). The personnel and equipment of this "operating unit" will move into position where "non-evacuables" have accumulated, and there proceed with roentgen and surgical activities before moving on to another similar location. After surgical treatment of these "non-evacuables," postoperative and shock care will be conducted by the "hospitalization unit," comprising one or two sections, each consisting of a tent hospital with accommodations for one hundred beds. After being treated to a sufficient extent to permit further carriage to the rear, the casualties who were previously considered as "non-evacuable" will be transported to evacuation hospitals.

As indicated on Figure 1, two roent-

cases where fluid may be suspected in the thorax, or free gas in the abdomen, it will be possible to support a patient in a sitting position and quickly shift the x-ray tube and screen for vertical fluoroscopy.

To provide for this range of manipulation, it was necessary to make use of shock-proof cables with the x-ray tube detached from the transformer tank. This requirement presented several problems, notably (*a*) limitation of fluoroscopic capacity—for, as is well known, the conventional arrangement of this sort has permitted fluoroscopy with 3 to 5 ma. and kilovoltages up to 80 for a maximum of only ten to twenty minutes—and (*b*) the risk of breakdown of the shock-proof cables. The utmost co-operation

has been given by the manufacturers in solving these two problems. Thanks to their keen interest[3] a continuous fluoroscopic rating (using milliamperages up to 5 with kilovoltages up to 85) has been provided by means of such improvements in tube housing design as the inclusion of an air circulator about an inner housing, the provision of an oil agitator, and the special construction of an unusually substantial x-ray tube insert. There has also been improvement of the design of shock-proof cable terminals. The U. S. Army is adopting a terminal slightly longer than that used conventionally (the male adaptor measuring 5 11/16 inches in length) and including a concentric ring type of contacts. With this terminal, pulsating potentials as high as 130 kv. (peak) have been withstood for two hours continuously, and 140 kv. for as long as one hour (test period). The concentric ring contacts provide for release of torsional strains and thereby reduce the likelihood of bending of the cables. Since breakdowns of cables usually occur at sites of strains or bends, it is believed that these improvements have eliminated difficulties which might ordinarily have been expected.

Figure 2 demonstrates the adaptation of the table unit for horizontal fluoroscopy and for fluoroscopy in the sitting and standing positions.

Many methods of foreign body localization have been studied and tested with experimental models.[4] It seemed essential that a method be adopted requiring no detachable small parts which might easily be lost. Equally important seemed to be speed of performance and the minimizing of exposure of the patient to radiation. Our method fulfilling these prerequisites involves two construction features and two adjustable attachments. The construction features include (1) the

utilization of a "C-shaped" arm supporting the x-ray tube and the fluoroscopic screen, providing for a fixed focal-screen distance of 66 cm., and (2) the incorporation of three sets of intersecting lines, inscribed for alignments on the fluoroscopic field (one of these intersecting lines is located in the center of the fluoroscopic screen while the other two are spaced 11 cm. in opposite directions from the central set, i.e., 22 cm. apart or one-third of the focal-screen distance). The two attachments are (1) a combination skin marker and depth scale, for measurement of depth of the skin level beneath the level of the fluoroscopic screen (located on its staging) and (2) a localization scale for indicating the depth of the foreign body beneath the skin level, similar in construction to a slide rule and mounted on the horizontal carriage of the table chassis. For the procedure of localization see Figure 3.

It has been mentioned that two roentgenologists are assigned to each mobile surgical hospital unit. At times, no doubt, both may be busy with fluoroscopy of incoming casualties, foreign body localization, and general studies in co-operation with the operating teams. Actually, however, one is really assigned to the hospitalization unit and the other to the operating unit. When the latter moves away to operate in another location, the hospitalization unit will be left with one roentgenologist (plus the other physicians assigned to it). His subsequent x-ray

PROCEDURE DIAGRAM

GEOMETRIC DETAILS

FOREIGN BODY LOCALIZATION

Fig. 3. Foreign body localization. Before proceeding with localization of a foreign body at an unknown depth, place depth phantom in position and check measurements. If indicated, adjust reading level on depth scale marker (this level is adjustable to provide for variations in the position of the focal spots of one or another x-ray tube).

1. Check fixation locks on "C-shaped" member; secure alignment of focal spot to center of fluoroscopic screen.

2. Align a prominence on foreign body to intersection of central intersecting lines.

3. Dampen skin marker pad with tincture of iodine or ink and adjust it to this alignment (foreign body and intersection of central intersecting lines); lower skin marker pad, until it rests on the skin, thereby marking it.

4. Read distance between fluoroscopic screen and skin by way of scale on depth marker (A).

5. Shift tube and fluoroscopic screen so as to align the same prominence of the foreign body, as considered in Step 2, to the intersection of either of the outer intersecting lines (B).

6. Slide localization scale and adjust pointer to the centimeter value coinciding with the centimeter distance between the fluoroscopic screen and the skin as measured in Step 4, above; clamp cuff for fixation of pointer to side rail of table.

7. Slide x-ray tube and fluoroscopic screen in direction opposite to that used in Step 5, above, until the same prominence on the foreign body becomes aligned to the intersection of the opposite outer intersecting lines (C).

8. Read on localization scale, the depth of foreign body beneath the skin.

In the diagram showing geometric details A-B equals spacing between outer intersecting lines; it is equal to 22 cm. F-S equals focal-screen

work will include fluoroscopy of various types and probably roentgen therapy for superficial infections, including gas gangrene (6).

Our x-ray machine unit provides for superficial therapy. Because of employment of a detached x-ray tube and shockproof cables, it was necessary to specify a high degree of transformer regulation. We have limited the inverse voltage to 12 kv.p. in excess of the useful voltage under a load of 30 ma. (meter reading) and at a useful potential of 85 kv.p. With such regulation of transformers and an x-ray tube of high heat capacity (as provided for continuous fluoroscopy at 5 ma. and 85 kv.p., allowing for safety margin), we found ourselves in a position, without further provision, to carry out superficial roentgen therapy at 4 ma. and 100 kv.p., continuous operation. Many believe that very little roentgen therapy can be expected in the mobile surgical hospital. Others (1, 5) insist that provision must be made for it. This has been done without any special apparatus except alumi-

distance (focal spot to intersection of central intersecting lines); it is equal to three times A-B, or 66 cm. (plus or minus minor deviations in the position of the focal spot).

If a foreign body were located at S (i.e., just beneath the intersection of the central intersecting lines), for its alignments to the intersection of the outer intersecting lines at A and then at B, the x-ray tube would have to be moved with the fluoroscopic screen for a distance equal to C-D (C-D equals A-B, i.e., 22 cm.). In the case of foreign bodies located at other levels below the plane A-B, the same ratio relationship would hold, that is, the range of travel of the x-ray tube and fluoroscopic screen for the alignment of the foreign body with points A and B, respectively, would be one-third the distance F-J.

Since the triangle E-J-G is similar to triangle J-H-I, the distance S-J bears the same ratio relationship to H-I as does J-F to E-G; that is, a three to one ratio.

H-I is equal to H-S plus S-I.

H-S equals G-D while S-I equals C-E; therefore, H-I equals C-E plus G-D; C-E plus G-D is the untraveled distance, with reference to the scale (22 cm. minus the distance of travel), which actually measures the location of the foreign body beneath the fluoroscopic screen.

The distance between the fluoroscopic screen to the skin is subtracted by making the adjustment of the pointer to an "arbitrary zero" as indicated in diagram B. Thereby, the reading of the untraveled distance (indicated on the localization scale) provides the measurement of the foreign body beneath the skin level.

num filters. The dosages for this work would, of course, be small and would be based upon predetermined calibration of r performance. Whether or not time will permit the administration of roentgen therapy at the mobile surgical hospital, this x-ray machine unit will doubtless be used for that purpose in one or another installation, for the same unit will be found in the evacuation hospital, in the general hospital, and in the station hospital.

stalled in the upper portions of the framework of the tent. So that it may be erected out of doors a one-foot pitch is provided for the purpose of shedding rain. It can also be erected in any room, cellar, or dugout, since ground poles and ground pegs are not used. If necessary, the side and rear curtains can be held down by piling sand bags, rocks, or even dirt upon their 18-inch over-length aprons. For adaptation as a film processing compart-
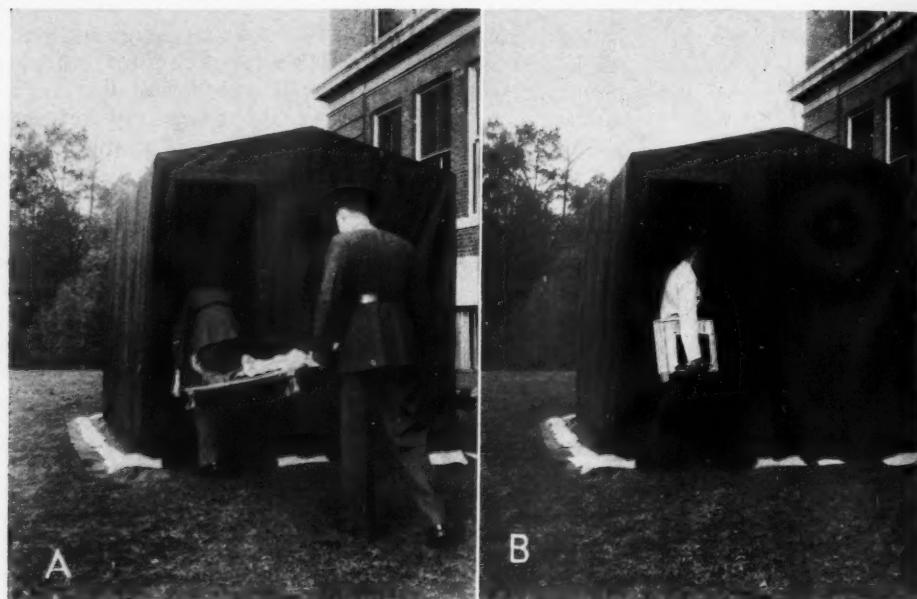

Fig. 4. Tent for fluoroscopy and/or film processing. *A* shows the position of the adjustable inner curtain for fluoroscopy while *B* shows the inner curtain set back in position for film processing. In this latter position, three drapes are extended for the development of a labyrinth—into which the technician is shown walking.

Fluoroscopic examinations might be conducted in a light-proof truck or in an "insert tent," which has been designed for either fluoroscopy or film processing. For fluoroscopic purposes, the inner front curtain is adjusted close behind the outer front curtain and flap arrangements are provided to admit the litter bearers and patient, as shown in Figure 4. After these have passed in or out, the curtains fall by their own weight, thereby providing for closure and a dark compartment. A light-proof motor-powered ventilator is in-

ment, the inner front curtain is set back 20 inches and three light-weight auxiliary drapes are extended so as to provide a labyrinth. It is not likely that this arrangement will be needed for the ordinary activities of the surgical hospital, since in that installation the rush of work would hardly permit roentgenography. Two of these tents, however, will be included for purely fluoroscopic purposes. It is anticipated that there will be times, when the tide of battle is favorable, at which this hospital will take over the activities of

the evacuation hospital and under such conditions at least one additional tent will be needed for film processing.

A gasoline electrical generator will be supplied for each mobile operating unit and each hospitalization unit, as a community electric supply can hardly be expected to be available. This generator is of special design such as to provide for a wave form very similar to that of the average community line. This feature is important for several reasons. Otherwise,

ator has a rated capacity of 2500 watts. Its weight, including its special field chest, is under 200 pounds. Because of the special requirements, it is listed in the supply catalogue as a separate item to be used exclusively for x-ray purposes. It will provide for operation at 30 ma. with a kilovoltage of 85 though, for the sake of a safety margin, warnings are appended that the operation be limited to 15 ma. The values for roentgen therapy can easily be satisfied.
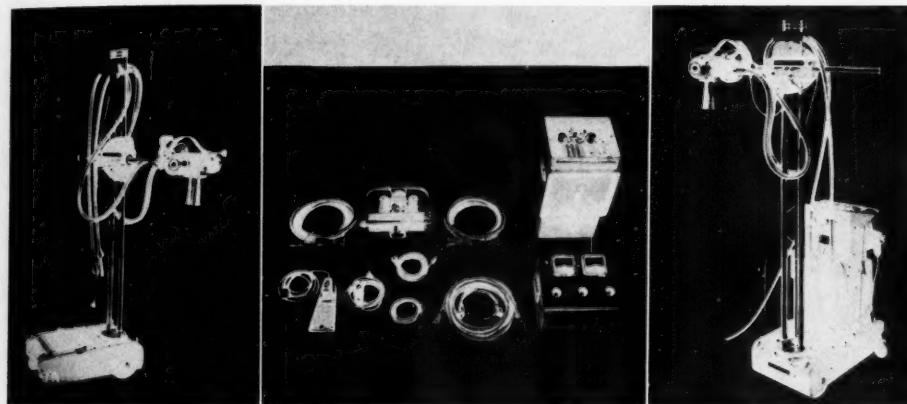

Fig. 5.   X-ray machine unit and the mobile x-ray chassis.   The figure to the left shows the chassis unit complete with a tube unit, cone, and pair of shock-proof cables.   All of these parts will be included with this unit as supplied in times of war.   Otherwise, the tube unit and cables shown with the x-ray machine unit (middle figure) will be assembled as needed.   The figure to the right shows the complete assemblage as this unit would be used for ward work.

the kilovoltage calibration values might not hold true, unfavorable surge values might result, and excessive inverse occur. Moreover, the performance of this gasoline generator must be sufficiently steady that when the high-tension circuit is opened by stepping off the fluoroscopic switch, there will be no appreciable racing of the engine with resultant overload of the filament circuit and destruction of the filament of the x-ray tube.[5] This gener-

Still another item will be included with the hospitalization unit of the mobile surgical hospital. This item we call a "mobile x-ray chassis." The component parts of the x-ray machine unit can be mounted upon it and with this combination there is developed a bedside unit, particularly for the administration of superficial x-ray therapy in the ward (and bedside roentgenography for installations other than the mobile surgical hospitals). This arrangement is shown in Figure 5.

The Evacuation Hospital.—The evacuation hospital provides treatment of a fairly definitive sort for those casualties which can be immediately transported to the rear by way of the "clearing station." Such casualties should reach it in twenty-

[5] Credit is due Mr. E. R. Goldfield and the Picker X-ray Corporation for their special testings of these performances and for recommendations which have led to the construction of a satisfactory gasoline electrical generator. Recognition is also accorded Mr. Robert Worth of the Homelite Corporation and Mr. D. W. Onan of D. W. Onan & Sons for their splendid co-operation in redesigning and reconstructing their generators.

four to forty-eight hours. It also receives patients treated at the mobile surgical hospital, as soon as they are in condition permitting further transportation. The evacuation hospital is usually located at a railhead, 15 to 30 miles behind the front lines. It may have accommodations for as many as 750 patients. It is a more substantial installation than the mobile

Fig. 6. The portable grid unit mounted on the horizontal carriage, in position for roentgenography. Note that vertical adjustment has been made so that the grid is at the level of the litter sag. The wafer grid itself is being lifted out from its housing, as is possible when it is needed for use in the ward. Note the cassette beneath the grid and its accommodation in a standard cassette tray.

surgical hospital; it is usually set up in a temporary building or in some building taken over for the purpose. Ordinarily, it can be expected to remain in one location for some months; therefore, heavier types of equipment are not impractical for it. For x-ray activities, however, it is expected to use the same types of equipment as described for the mobile surgical hospital. As shown in Figure 1, the personnel of the x-ray department will in-

clude one captain and one lieutenant (as roentgenologists), and seven technicians. Most of the work will be fluoroscopic, though it is estimated that perhaps 10 per cent of the activities may be roentgenographic. Therefore, films and cassettes and dark room equipment must be provided. The films and cassettes will be transported in standard Carlisle field chests; the ones accommodating films will be lead lined. The light-proof insert tent, described above, can be installed in any room so as to provide quickly for film processing.

A special loading bin and dryer combination has been developed,[6] consisting of two compartments, providing for easy portability. One compartment is lead lined for the protection of films and loaded cassettes. This compartment is designed for mounting upon the dryer compartment, and with this combination a loading bench is provided. The dryer compartment contains a heating element and an air circulator and accommodations for eighteen films in hangers.

A special processing tank unit has likewise been developed.[7] This unit also consists of two compartments, providing for portability. The base compartment contains a heating element and a refrigeration element, plus a mixing chamber, thermostatic regulator, and water circulator. The tank compartment has a capacity of 50 gallons and accommodations for two insert tanks of sizes varying from 3 to 10 gallons. A rack is provided for suspension of no less than eighteen hangers for washing of films. This tank compartment is designed for mounting upon the base compartment and the unit is ready for operation after merely connecting two water circuit couplings, filling the master tank compartment with water, and connecting the line cable to a socket for electrical supply. Community plumbing connec-

tions are not necessary, though provision is made to utilize either a cold water supply alone or cold and hot water supplies. The insert tanks are of stainless steel, providing for durability, ease of cleaning, and rapid temperature exchange. If necessary, an auxiliary wash tank may be introduced into the circulating system.

As mentioned, the equipment for fluoroscopy and roentgenography will be the same as that used at the mobile surgical hospital. The tube-supporting member of the table unit can be rotated over the table chassis for roentgenography with the patient in the horizontal position. The table top itself is a removable litter. This feature would seem to be ideal, since it makes it unnecessary, for either fluoroscopy or roentgenography, to move the patient from a litter to a table-top and back again to the litter. In order to obviate the necessity of even raising the patient for placing a film beneath him, there has been designed a special grid arrangement. As shown in Figure 6, this grid can be mounted upon the horizontal carriage of the table unit. Its design is such as to provide for elevation adjustments of the grid and cassette to variable levels depending upon the sag of the litter with the weight of the patient. The grid itself is of wafer type. It is planned that a spring arrangement shall be incorporated to provide vibration of this grid for reduction or elimination of the grid markings. This is still in the developmental stage. The design does provide, however, for completely detaching the grid and carrying it as a cassette for use at the bedside.

The supporting arm for the x-ray tube can be adjusted in the vertical plane so as to provide for varying focal-film distances, the cassette being placed in the cassette tray, immediately beneath the grid. The true radius of this grid is 36 inches, but it can be used with focal-film distances varying from 28 inches to 48 inches without appreciable cut-off. Moreover, the grid itself may be removed and the cassette simply placed in the tray beneath the part to be studied. The x-ray tube can be adjusted to a 90° rotation whereby sitting or standing roentgenography may be performed with focal-film distances varying up to 6 feet or more. Moreover, the tube may be adjusted so that 6-foot focal-film distances may be utilized with the patient lying on the litter upon the floor.

The General Hospital.—After treatment at an evacuation hospital, casualties might be returned to duty or they might be evacuated further to the rear, in which case they would be transported to a general hospital. General hospitals are usually located thirty miles or more behind the front lines. They serve to provide special and prolonged treatment, when indicated. As a unit, a general hospital may be considered to accommodate 1,000 patients. There may be multiples of such units, whereupon there would be developed a "hospital center," having accommodations for 2,000 or more patients. These installations are usually of permanent or semi-permanent construction. The radiological requirements are as varied as would be expected for any large institution in civil practice. To each 1,000-patient unit there will be assigned one major (as radiologist), one captain and one lieutenant (as roentgenologists), and eight enlisted technicians. Equipment such as described for the other installations will be found here, and, in addition, larger equipment of conventional commercial design. There will be a 100 ma. single tube, double-duty unit, as well as a 200 ma. unit and four to six conventional bedside units. Roentgen therapy equipment will be included, as well as various other types of special apparatus.

The Station Hospital.—Station hospitals are not included in the line of evacuation for actual battle casualties. They provide for medical and surgical care of personnel connected with units which are not actually engaged in conflict. Their location is usually 10 miles or more behind the front lines. These hospitals vary in capacity from 25 to 250 beds, or more. Provided the professional activities warrant, a roentgenologist may be included among their doctor-personnel. This roentgenolo-

gist may be of rank as high as a major and he may be assisted by as many as five technicians. It is believed, however, that all the roentgenological needs for this installation can be provided with the equipment which has already been described for the evacuation hospital.

SUMMARY

It is planned that roentgenological studies will be included as an important phase of the physical examination of candidates for service in the U. S. Army. Ultimately, roentgenographic studies of the chest, using the method of photography of the fluoroscopic image, will be accomplished routinely before acceptance and again before discharge. In this, the objectives are threefold: (1) to eliminate those whose physical condition would not withstand the rigors of army life; (2) to avoid dissemination of tuberculosis because of the close contacts incident to groupings of large numbers as required in the service; (3) to maintain graphic records of chest conditions in order to provide for proper adjustment of any claims which might be made against the Government.

For the theatre of operations the designing of equipment has been governed by at least three axiomatic principles: (1) versatility of adaptation to the extent that each piece of equipment will function not merely for a single purpose, but for several requirements and installations; (2) portability to the extent that disassemblage of each item can be easily accomplished and that the component parts can be easily carried, the weight of any one part not exceeding two hundred (200) pounds, and (3) practicality of design to the extent that the equipment can serve the requirements of function in peace-time installations as well as in zones of combat. Relative to this last principle, certainly this equipment should be thoroughly understood by those who are to use it under occasions of combat. A thorough acquaintance as to handling it can best be obtained by using it day after day for ordinary routine activities. Moreover,

its use in times of peace will no doubt lead to improvements so that it will not be necessary on mobilization day suddenly to develop new designs in order to incorporate new principles that may be discovered. In addition, two other attributes are provided by this general principle of designing war-time equipment in such a way that it is practical for use in peacetime installations: (1) a war reserve stock of supplies is provided so that, in case of a sudden emergency, equipment will be available for moving into the field without awaiting supply from manufacturers; (2) because of steady purchases, the manufacturers will be informed as to just what the army will need in large quantities, and they will therefore have set up the necessary jigs, dies, and other tools necessary for uniform and large-scale constructions.

Applying these principles, the combination x-ray table unit, x-ray machine unit, and mobile x-ray chassis were designed to provide for a nine-way adaptation; (1) horizontal fluoroscopy; (2) foreign body localization by means of a rapid fluoroscopic method; (3) sitting fluoroscopy, the design of the x-ray tube and screen supports providing for easy and quick shifting for the study of a patient supported to a sitting position on the litter; (4) standing fluoroscopy, to the extent of accommodating routine chest studies and also gastro-intestinal studies; (5) horizontal roentgenography, with conventional focal-film distances from 25 to 40 inches; (6) six-foot vertical chest studies; (7) six-foot horizontal chest studies, the patient lying on a litter, upon the floor; (8) ordinary bedside work in the wards, by means of mounting the component parts of the x-ray machine upon a mobile chassis; (9) superficial roentgen therapy, to the extent of milliamperage capacities of 4 and kilovoltage potentials up to 100.

In conjunction with this apparatus, there has been developed a wafer type of grid arrangement, adaptable two ways: (1) for use with the table unit referred to

above, and (2) for bedside work in the wards.

A light-proof tent has been designed in such a manner that it may be erected on the outside, within an ordinary corridor or ward tent, and within a room, cellar, or dugout. This tent likewise has been designed for a two-way adaptation: (1) with one arrangement, it provides for a fluoroscopic compartment; (2) with another arrangement, it provides for a film processing "dark room."

The two-compartment film and cassette loading bin, dryer, and loading bench combination has been designed in such a manner that it is believed to be practical for our small hospital installations. And yet by using multiples of this same unit, it is believed that the needs for our largest hospitals are provided. Moreover, it is believed that this equipment is of a design practical for use not only in any of our peace-time installations, but also for the installations in the field.

A two-compartment processing tank has been designed for large or small hospitals as set up for peace-time needs or for use in the theatre of operations.

The gasoline electrical generator is the only item which so far might be considered a "special item." This is due to our particular requirements, such as constancy of performance and an electrical wave form closely paralleling that of the average community line. These requirements have been rather unusual for the manufacturers of these small electrical generators since they have not had to contend with half-wave loads and loads as intermittent as are required for x-ray purposes.

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MEDICAL PREPAREDNESS IN THE NAVY[1]

WITH SPECIAL REFERENCE TO RADIOLOGY

By Captain LUTHER SHELDON, Jr., M.D., *Medical Corps, U. S. Navy*

THOUGH not primarily a radiologist, I have learned in my work as a medical officer of the U. S. Navy, on shore and afloat, something of the value of radiology in its relation to other branches of medical science and have come to realize the important part it must play in any plans which the Navy Medical Corps may make to meet a major emergency, or even a great peace-time expansion, such as the present development of a two-ocean navy.

Among the many advisory committees which have been brought into being in connection with the Council of National Defense, whose duty it is to study and advise upon special problems, is a Medical Advisory Commission, of which the Surgeons General of the Army, Navy, and Public Health Service are members. This Commission is organized to advise upon all medical problems, including the way in which radiology may best be used in the scheme of national defense. The responsibility placed upon radiologists will be great, and they will play a large part in minimizing the damage done by disease in the Navy's expansion, and by disease and injury in the event of war.

A British medical officer recently made the statement that the crying need in England, so far as medical personnel is concerned, is for more and better trained radiologists and what the British call radiographers, or, as we in America call them, x-ray technicians.

So far as personnel is concerned, the problems of the Navy are not nearly so great as those that must be met by the Army. The Army may expand to any proportion. The Navy's expansion is necessarily limited by the number of ships which can be built or placed in commission and effectively maintained by navy yards, supply depots, and other shore activities. *The Fleet is the Navy.* All shore activities, including the Navy Department, exist to maintain the Fleet at its highest state of efficiency. This is true also of the Medical Department of the Navy, which has but one function to justify its existence: "to keep as many men at as many guns as many days as possible." To accomplish this, we must begin at the beginning; that is, in the recruiting stations. The care exercised by the medical officer in examining applicants for the Navy plays a large part in determining the efficiency of the Fleet as a fighting force.

An x-ray examination of every applicant is a desirable, but expensive and impracticable, procedure. Every applicant, however, who is accepted for enlistment is sent to naval training stations, where he is kept in detention for a period of three weeks in order to permit the development of any of the common communicable diseases to which he may have been exposed, and thus prevent their dissemination throughout the Navy. During this period a second examination is made, and any obviously unfit who may have managed to get by the medical officer at the recruiting station are discharged and returned to their homes. At this time, it is possible to make x-ray studies of the chests of all recruits. This we are attempting to do, and we believe that thus we shall prevent the appearance of any large number of cases of tuberculosis among the Navy personnel and, incidentally, save large sums of money which might otherwise have to be paid out for pensions to those invalided from the service by reason of the disease.

The matter of mass x-ray examination of the chest has been one of deep interest for many years. The Navy has given it

much study and has reached the conclusion that photoroentgenography offers the most satisfactory method available. The use of the 14 × 17 inch film has been considered, but this is too slow and expensive; the 4 × 5 inch film, which is cheaper, is also slow; the paper film is excellent, but, so far as we see, offers no advantage over the method we have adopted and the cost is greater. We have decided, therefore, to employ a photograph of the fluoroscopic chest image made on a 35-mm. roll film. By this means chest pictures can be made satisfactorily, rapidly, and also cheaply. At present, this method is being used at two of our largest training stations. When we have obtained about 10,000 pictures, and found them satisfactory, we plan to extend the use of the method to the other naval training stations, the Marine Corps bases, and the Naval Academy. There are some, to be sure, who say that the small picture does not give the definition that may be obtained in larger films, and that certain parts of the lung fields are obscured, but we believe that modern improvements have so increased the technical excellence of these miniature films that they are entirely suitable for survey work such as we are attempting. The cost is only about one-fiftieth that of a 14 × 17 inch film.

It is because of our appreciation of the necessity that no one with incipient tuberculosis be enlisted in the Navy, and the realization that physical signs alone cannot be relied upon to detect the earliest cases, that we have adopted this rapid method of roentgen examination of the chest. We realize also, that it would be little short of criminal, once having discovered recruits with tuberculosis, to discharge them from the Navy and allow them to wander at large through the country, spreading the disease, until such time as they are incapacitated and, necessarily, come under the care of physicians. Consequently, we plan to send all men with positive or suspicious evidence of the disease to naval hospitals for study. If the diagnosis of tuberculosis is confirmed,

they will be discharged from the service as having a disease that existed prior to enlistment, thus eliminating any claim upon the Government for pension. State or local health authorities in their home communities will be notified of this action, in the hope that steps will promptly be taken to place the discharged men under treatment, thus giving them a chance of recovery and, at the same time, protecting the community. Local health authorities will be requested to report to us at the end of six months on each case. In this way we shall learn of any mistakes we may have made.

When, a little more than a year ago, war broke out in Europe and it appeared not unlikely that our country might become involved, the President declared a state of "limited emergency." At that time, the Navy had 832 regular naval medical officers on duty, a number obviously inadequate to man all the new ships—and old ones being placed in commission—to serve the new and expanded Marine Corps units and, at the same time, keep our hospitals, dispensaries, training stations, air stations, recruiting stations, navy yards, and other activities adequately staffed. Effort was made to build up the Regular Corps, but this is a slow process and only 47 officers were added to the Medical Corps in the past year. With the declaration of a "limited emergency," we were authorized to place on active duty retired officers of the regular Navy who volunteered for recall, and were physically fit, as well as members of the Reserve Corps who volunteered and were qualified physically. More recently the recall to active duty of retired officers and reserves, whether or not they volunteer, has been authorized. This has eased the situation greatly, but we are still short of the number of officers required. Up to Nov. 10, 1940, there were 60 retired officers and 189 volunteer reserves on active duty, making a total of 1,128 medical officers on duty on that date. Since that time there has been little change, although the Navy and

Marine Corps have steadily increased in numbers.

It has been recognized for some years that the strength of the Medical Corps of the Navy should be 0.65 per cent of the total strength of the Navy and Marine Corps. Today the total strength of the Navy and Marine Corps is about 250,000. We should, therefore, have 1,625 medical officers. Instead we have less than 1,200. Every effort is being exerted to obtain desirable young medical men for the Navy, both in the regular service and the reserve, and we believe we have much to offer them. Those connected with teaching institutions are asked to present to the students under their instruction the advantages to be gained by aligning themselves with the Navy in the system of national defense.

. When a young doctor decides to practise his profession in the Navy he is not giving up his ambition to go far in his life's work or to reach the top in any specialty he may choose. On the other hand, he makes his choice to spend his active life under conditions which will give him all opportunities to develop his talents in his chosen field, and, at the same time, become proficient in naval medicine, a speciality in itself and an important one. All he sacrifices is hope of large financial gain. That the Navy does not offer.

Specialization in the Navy is not new. From its beginning officers have specialized in deck duties, navigation, gunnery, the building and repair of ships, and engineering. In the early days a medical officer was perforce obliged to be able to meet any emergency that might arise, medical or surgical. To some extent this is still true. All medical officers of the Navy, because they are frequently called upon to serve alone on small ships, or at isolated stations where no consultant may be called, must be able to operate upon patients presenting the symptoms of acute appendicitis, a ruptured intestinal ulcer, a strangulated hernia, intestinal obstruction, or other surgical emergency, as well as to treat compound and simple fractures,

and care intelligently for the victims of such medical emergencies as the pneumonias, coronary thrombosis, and other acute diseases. This ability, plus knowledge of preventive medicine, hygiene, and sanitation, especially as applied to life aboard ship, an acquaintance with tropical diseases, and an understanding of the psychology of men living among themselves, together with an insight into finance, and a complete familiarity with naval regulations and customs, constitutes the specialty of Naval Medicine. This in itself is no small specialty, but it is not enough.

The advances made in the science of medicine in recent years have been so great that no one man can hope to have knowledge of all of them. Consequently, in the Navy, just as in civil life, it has been the practice to encourage and develop specialists in various branches of medicine. Today we have specialists in internal medicine, general surgery, otolaryngology and ophthalmology, neuropsychiatry, orthopedics—even in pediatrics, obstetrics, and gynecology—the laboratory sciences and, last but not least, radiology.

Roentgenology in the Navy is very similar to the science in civilian practice, with the same variations depending upon the size of the institution and the personnel available. The large hospital is called upon to make roentgen examinations embracing the entire field, including even the more difficult procedures, such as encephalography and ventriculography. All of the methods of gastro-intestinal examination are utilized as indicated, and these, too, call for trained personnel. The large hospitals also maintain schools for x-ray technicians in which hospital corpsmen are trained in sufficient numbers to supply the ships with men who can do routine radiography.

Shortly after Roentgen's great discovery of the rays which bear his name the Navy interested itself in radiology. As early as June 24, 1897, Surgeon George E. H. Harmon of the United States Navy, then on duty at the Naval Academy in Annapolis, reported to the Surgeon General

that there was a "very efficient and well-installed x-ray plant" at the Academy. This "plant" was in the department of physics and chemistry, under the direction of Prof. N. M. Terry. Among the curiosities at the Academy had been an old Crookes tube, and with this tube Professor Terry had made "very good x-ray pictures" within two weeks of the publication of Roentgen's discovery. Doctor Harmon wrote that Professor Terry had offered every facility for the use of the x-ray machine to the Medical Department of the Naval Academy. He states: "We have repeatedly availed ourselves of this satisfactory aid in cases of fractures, bullet wounds and gunshot wounds of the hand, bony exostoses of fingers, and deformity resulting from badly united fracture of the forearm."

The first installation of x-ray apparatus by the Medical Department of the Navy was probably in 1898, on the ambulance ship—later the hospital ship—*Solace*, as a gift from the National Society of Colonial Dames of America. In 1900, apparatus was purchased for the naval hospitals in Cavite, Philippine Islands, and Yokohama, Japan. Since then, the Medical Department of the Navy has kept pace with civilian hospitals and institutions in the use of x-rays. Today modern outfits are to be found in all naval hospitals, on hospital ships, and at the larger shore stations. The medical organizations accompanying expeditionary forces carry x-ray outfits as part of their equipment. Also, wherever Navy dental officers are stationed, dental x-ray units are provided and these units are frequently used as diagnostic aids. In addition to the standard equipment for diagnostic purposes, all the larger naval hospitals have facilities for superficial and deep x-ray therapy.

The Medical Department of the Navy is not primarily a research organization. Whatever is used in the care of the sick and injured must have been tried and found worthy. This does not mean that we are not interested in new discoveries. We are, but we do not use our personnel for

experimental purposes. This applies to new developments in roentgenology as well as to new drugs. All must be tested before adoption. For this reason, there is maintained at the Naval Medical Supply Depot, Brooklyn, a well equipped testing laboratory, where all equipment must be tested and approved prior to purchase.

No matter how efficient apparatus may be, it is of little value without trained personnel to handle it. For this reason, the Medical Department of the Navy has, in all normal times, a number of medical officers under training in civilian institutions and in its own hospitals, in radiology. Dental officers, too, are trained in the use of dental x-ray apparatus and the interpretation of dental films. In addition, a large number of enlisted men of the Hospital Corps have been trained and are functioning as x-ray technicians and assisting the officers in their work.

At present there are in the Medical Corps of the Navy 46 medical officers designated as roentgenologists and 2 undergoing instruction. Unfortunately, with the rapid expansion of the Navy we have been forced to curtail our special courses in order to fill necessary billets. This, we hope and believe, is only a temporary setback to our normal plans. Many of our radiologists, we are proud to say, are diplomates of the American Board of Radiology.

In addition to the medical and dental officers trained in roentgenology, we have 7 officers of the Hospital Corps who are qualified to supervise the installation of x-ray apparatus, and 184 enlisted men of the Hospital Corps who are qualified x-ray technicians. Twenty-three enlisted men are now being trained as technicians. Such of these technicians as are certified by the Surgeon General to have completed the prescribed course of instruction, and subsequently to have had two years' active x-ray duty, are eligible for the American Registry of Radiological Technicians after passing the required examination.

The Navy maintains no special hospitals for the diagnosis and treatment of malignant neoplasms. In practice, diag-

nosis is made at any naval hospital. When the diagnosis of malignancy is established, the patient is usually transferred to the naval hospital in Brooklyn, if on the east coast, or to the naval hospital in San Diego, if on the west coast, where special facilities and contacts make available the latest and best treatment.

The Medical Department of the Navy owns no radium, but radium belonging to the Bureau of Mines of the Department of the Interior has been deposited with Memorial Hospital in New York and the Howard A. Kelly Hospital in Baltimore. In each instance the amount is about 750 mg., and this is available for the treatment of naval personnel. Since the Navy began to care for the dependents of its personnel, it has, naturally, been called upon to treat many cases of uterine cancer by radium. Usually, in such cases, arrangement is made with a local doctor who owns radium for its loan or rental. Instruction of naval medical officers in the use of radium has been generously and freely given by experts in the cities in which naval hospitals are located. This has been of inestimable value.

To indicate the amount of x-ray work done in naval hospitals, a few figures may be given. During the year 1939, at the Brooklyn Naval Hospital, 5,916 radiographic examinations were made; at Canacao, in the Philippine Islands, 2,729 pictures were taken; even in Guam, 580 x-ray examinations of various sorts were made; while in Norfolk, more than 12,000 such examinations were made, and in Philadelphia nearly 18,000. At San Diego, a large amount of radiographic work was done, but accurate figures in this instance are not now available. Thus it is seen that a vast amount of radiological work is carried on in the Navy. It is of the same types that are encountered in civil life, such as examinations of fractures, gastrointestinal and gallbladder series, examination of lung fields, heart measurements, location of foreign bodies, ureterography.

One of the matters now under investigation in the Navy, and one in which great interest is being taken, is the application of trivision stereoscopy to roentgenology. With the aid of recently devised technical developments, we expect to obtain on a single photographic film a panoramic type of stereoscopic view of any particular region of the body in which we are interested, and at whatever depth we desire. This we believe will make possible more accurate localization of lesions in the lungs and will give a better idea of their extent than can now be obtained by any means available. Furthermore, it is hoped by this method to localize foreign bodies with a greater degree of accuracy than has hitherto been possible. The nature of the film and the technic of its use are such that the resulting image gives a vastly improved depth perception over any method with which we have been familiar in conventional stereoscopy. It is thus hoped to obtain accurate three-dimensional perspective in a single film. Hence, the term "trivision," which has been suggested for this type of roentgenography. It provides, so to speak, a stereoscopic view plus a peep around the corner.

In closing, a few words may be said about the Naval Medical Reserve Corps. It is upon the Reserve that we must depend for building up an adequate medical corps for the Navy in the event of mobilization. To-day, we have approximately 1,700 commissioned officers in the various classes of the Medical Corps of the Naval Reserve, of whom 77 are specialists in radiology. If all of these were called to active duty we should have about 2,900 medical officers, by no means enough to meet the demands of a Navy expanded to war-time strength. Hence, our urgent desire to commission more officers in the regular Navy and in the Reserve. We need, especially, younger men, who can go anywhere and do anything that may be required of them, as we feel that our administrative positions will be adequately filled by the more senior officers now available. We look to members of the Radiological Society to help us obtain these young men.

THE RELATION OF THE UNITED STATES PUBLIC HEALTH SERVICE TO THE PREPAREDNESS PROGRAM[1]

By JOHN E. WIRTH, M.D., *Research Fellow, National Cancer Institute, Bethesda, Md.*

THE question has been asked: "What, under the present existing conditions, are the plans of the U. S. Public Health Service for preparedness and what help and assistance can the radiologist specifically give?"

One of the main purposes of the Public Health Service in such an emergency as exists to-day is to support the military processes by any or all of its facilities. At the same time it must see that the general public health standards are maintained as high as possible. It is, therefore, one of the champions of civil health interests. It is an agency with widely diversified interests by virtue of numerous statutory obligations. Some of these are semimilitary, but the majority deal with civil life, and are met through eight divisions: Mental Hygiene, Scientific Research, Foreign and Insular Quarantine and Immigration, Sanitary Reports and Statistics, Marine Hospitals and Relief Stations, Personnel and Accounts, Domestic Quarantine, and Venereal Diseases.

In an address before the New York State conference of health officers and public health nurses at Saratoga Springs on June 25, 1940, Dr. Thomas Parran, Surgeon General of the U. S. Public Health Service, made the following statements:

"I would discuss with you the aggressive action which you and I, by virtue of our calling—because we are the servants of peace—must take to build up national strength. The needs to be met are enormous in scope, yet simple in analysis. National strength can be built up only by the adequate application of all the sciences to the provision of armament, munitions and supplies, food, and manpower. Our job is manpower.

"Seven competent, trustworthy persons recently were called to assist the Government in national defense. Industry is represented, both in raw materials and processing. Labor, agriculture, transportation, the consumer, are represented. There is a shrewd eye on the stabilization of prices. Research problems in the physical and chemical sciences are being attacked with vigor by an able committee, which will apply all the knowledge we have or can discover to the perfection of armaments. Yet, so far as I know, there has been no more thought than in 1917 of the application of medical and public health science to the physical problems of a nation arming.

"Yet for what cause is this nation arming if not on behalf of the men, women, and children who compose it. Their physical fitness, their freedom from preventable disease, their morale or mental stamina, will determine almost entirely the effectiveness of all other defense efforts. Important in the easy days of peace without a cloud on the horizon, it is urgent now that the people of this nation be physically tough, mentally sound, and morally strong. If we are not, to quote Mr. MacLeish, 'we can leave our planes unbuilt and our battleships on paper. We shall not need them.'

"In time of stress, the health problems of the military and civilian population are inseparable. At present they are the responsibility of many unrelated Federal agencies having the happiest personal good will toward one another, but with no more official authority or compulsion toward coördinated action than did an airplane factory and an automobile plant two months ago. Each of these agencies legally can perform only certain functions set up by law. None of them has a close, working integration with the organized medical and public health professions. The State health departments are as diverse as the forty-eight states. None of the official agencies has the full aid and service which the public-spirited foundations set up to promote health and welfare are able to give.

"Our defense plans, for the immediate emergency, are still young. There is much in the way of organization and coördination yet to come. But as a first step in meeting the vital needs of manpower preparedness I propose that a coördinator of medical and health preparedness for national defense be appointed under the National Defense Council. There is much for him to do. He would work with and through the Surgeons General of the Army, the Navy, and the Public Health Service, other Federal agencies, and the national voluntary organizations concerned with the prevention, diagnosis, and treatment of disease."

In addition to the above recommendation Dr. Parran discussed the problems associated with the listing and classifying of professional and technical personnel; planning and aiding the recruitment and mobilization of medical personnel; intensification of the machinery to deal with the venereal problem in the areas of military and industrial mobilization; the handling of cases of tuberculosis discovered by draft boards; the problem of essential drugs; the coördination of research for the practical prevention of certain communicable and infectious diseases which are such major hazards to successful defense; the prevention of depletion of civilian doctors; the possibility of an organization to take care of correctible defects of enrolled men.

On Sept. 19, 1940, the President approved an order establishing a Health and Medical Committee to advise the Council of National Defense and to coördinate health and medical activities affecting national defense. The order stipulated, among other things, that the Committee should consist of the following members: Dr. Irvin Abell, Chairman, the Surgeons General of the Army, Navy, and Public Health Service, and the Chairman of the Division of Medical Sciences of the National Research Council. It stipulated also, and I quote:

"It will be the responsibility of the Committee to advise the Council of National Defense regarding the health and medical aspects of national defense and to coördinate health and medical activities affecting national defense. In carrying out its functions, the Committee may (a) utilize, to the extent that such facilities are available for such purpose, the laboratories, equipment, and services of the Medical Department of the Army, and Navy, of the Public Health Service, and of other Government institutions, and (b) within the limits of the appropriations allocated to it, contract with and transfer funds to such institutions, and enter into contracts and agreements with individuals or educational or scientific institutions for studies, experimental investigations, and reports."

In the Sept. 27, 1940, issue of *Public Health Reports* is a summary of a meeting of state and territorial health officers,

members of the United States Public Health Service, personnel of the National Advisory Health Council, officers of the Army, the Navy, and other branches of the Federal Government, representatives of voluntary health agencies and of the several professional organizations concerned with different elements of public health and medical service. This report deals with some of the items of the vast problem associated with preparedness in relation to the radical changes in modern military work and demonstrates that more attention will have to be paid to civilian problems and casualties. This is far too large a project for any one agency and can be accomplished only by coördinated effort and thought, as was brought out by this group in its discussion of such subjects as health services for National Youth Administration enrollees; physical rehabilitation of registrants disqualified for duty with the armed forces; serologic tests of registrants for military service; pertinent needs in industrial hygiene; health aspects of civil defense; control of selected communicable diseases; health administration problems arising out of mobilization; census of public health personnel and facilities; administration of the Selective Training and Service Act of 1940.

Since September attempts to meet many of these problems have taken on a semblance of form. The Health and Medical Committee of the Council of National Defense has appointed six sub-committees on hospitals, dentistry, medical education, industrial health and medicine, nursing, and Negro health, to deal with broad problems of policy. It has requested the National Research Council to create committees on aviation medicine and neuropsychiatry, in addition to its many other committees which deal with actual technical details, and to hand these problems over to capable private or public agencies to work out.

We are better prepared to-day, medically, than ever before, due both to the accumulation of medical knowledge and to many other factors, but much remains to

be done. This is especially true in the field of industrial hygiene. Rapid changes in industry make it essential to maintain continuous research, to develop devices for the prevention of new hazards, to expand industrial hygiene services for the health of workers and dovetail them more efficiently with community protection of their families. The Public Health Service cannot do this alone. It has no increased allotment or personnel to care for such functions. Its policy is one of retraction in all fields not related to the emergency—but this must be limited if the Service is to maintain present public health standards. It has assigned a physician and engineer to each of the nine corps areas of the Army to act as liaison officers between civil and military enterprises. It would be desirable—and may be possible—to assign men to each cantonment area for a similar function. It has formed a sort of flying squadron composed of physicians, chemists, and industrial hygiene experts who may be released, as occasion arises, to train and help personnel in local areas to meet the increased problems of industrial health and medicine incident to our greatly expanded industrial program. Only 15 per cent of the industrial workers in the United States are employed in industries which provide organized facilities for the maintenance and promotion of the health and hygiene of employees. The remaining 85 per cent are engaged in industries which have no organized facilities for industrial hygiene services and rely upon local general practitioners for the care and treatment of occupational disease or injury.

The Public Health Service has assumed certain responsibilities for the routine serologic tests of enrollees during the selective service program, and has intensified the machinery to deal with the venereal problem in the areas of military and industrial mobilization. The scope of this problem is indicated by the estimate of the Veterans Administration that in the last eighteen years—beginning five years after the war period—it has poured out not less than $82,000,000 in payment of compensation, benefits, medical care, and hospitalization for conditions due to venereal disease.

The Public Health Service has converted part of the Rocky Mountain Spotted Fever program in Helena, Montana, to the manufacture of yellow fever vaccine. It is heavily engaged in many such research efforts related to defense. It has not the power or funds to buy up and store essential drugs but it has figures on the available amounts and can advise private industry on these matters. Through its influence and the splendid co-operation of the American Medical Association in the listing and classifying of medical personnel it may be possible to avoid depletion of civilian doctors.

As Dr. Parran has aptly stated, "it would be easier for all of us, perhaps, if some master mind were to work out a gigantic blue print defining the specific task and detailing the next step for each doctor, health officer, health worker, and citizen in this vast human responsibility which confronts us. But the thing Americans are willing to fight for, if they must, is the sharing of responsibility for the common good—the co-partnership among men of good will and intelligence for the ends upon which we all agree but which must be worked out by methods as diverse as the thousands of communities where the problem is met."

It would be well in the training of new radiologists and technicians to stress the oft-forgotten subject of protection from over-exposure to radiation. This is particularly true in the expanding field of commercial radiology. The roentgenologist in each community shares a grave responsibility when he serves on his local draft board and detects and weeds out cases of tuberculosis. It would be poor policy to repeat the mistake of the last war, when men with active foci of infection were sent back home to work in industry and spread tuberculosis among their families and associates. The Public Health Service cannot solve this problem alone; it involves territorial, state, and

local health officials as well as organized medicine, private physicians, philanthropic organizations, industry, labor organizations, and the private individual. The degree to which this, as well as many similar problems, is met locally is a measure of our success in doing things in the democratic way. The fear expressed by many is that the greater the emergency the greater will centralization become. The extent to which this occurs will be determined by the degree of concern of each person with our present way of life and the diligence and spirit of public service with which he performs each task as it arises.

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OBSERVATIONS GLEANED FROM CLINICAL AND RADIOLOGICAL CHEST EXAMINATIONS OF RECRUITS[1]

By W. H. McGUFFIN, M.D., F.F.R. (London), F.A.C.R., Consultant Radiologist, Military District Number 13, *Calgary, Canada*

WITH the advent of the World War Number II the British Empire, of which Canada is a part, has been forced to defend the principles of democracy. The manhood of our sparsely populated land is rallying to the colors. From these men we are striving to build a force free from physical defects, and the radiologists are playing an important rôle in this constructive program. They are the national watch-dogs, looking for the unfit recruits who would be a handicap and an expense to the country.

It has been computed that each man connected with the Army, Navy, or Air Force who becomes incapacitated while in the service, and later is a pensioner, costs the country thousands of dollars. To date, the radiologists of Canada have been responsible for the rejection of fifteen men out of every thousand recruits who have passed the first medical examination at the time of enlistment. Not only have the radiological examinations been a saving to the nation, considered financially, but also from the angle of efficiency, for the presence of the incapacitated within the war machinery is a tremendous handicap to progress. The recruit, also, is saved the humiliating necessity of being demobilized later, when he fails under the strain of arduous duties. The films, moreover, constitute a record of the recruit's chest condition at the date of enlistment, and will be valuable in determining whether an existing condition is aggravated by service, or is a new development during service.

The medical examination of the recruit, as relates to radiology, includes (1) medical examination upon application for enlistment; (2) radiological chest examinations of those considered to be physically fit, conducted in the postero-anterior standing position, with films 14 × 17 inches, x-ray target at 6 feet distance from the film, exposure a tenth of a second or less, focal spot of the tube approximately 4 mm. or less; (3) when the films cast doubt upon the recruit's fitness, a clinical examination by a specialist in heart, lung, or surgical diseases as the case may require; (4) a review of the doubtful films by the consultant radiologist, who meets with the clinical specialists for classifying the recruit. The photo-fluoro-radiographic method has not been used in our survey, though I understand that the U. S. War Department has considered this method favorably.

In addition to the consultant radiologist for Canada, each province has a consultant radiologist, as well as lung, heart, and surgical specialists, men who have been selected for their proved ability. The provincial consultant radiologist, working in collaboration with the clinical specialists, has been of inestimable value to all concerned. The recruit of doubtful chest fitness is examined by the clinician, and with his findings and the x-ray film as evidence, the clinician and radiologist weigh the results, pro and con, and the recruit is classified into one of the following categories:

Fit for active service: Can undergo severe strain. Has no serious body defects.

Fit for lines of communication: Can undergo considerable exertion, not involving severe strain.

Fit for service in Canada only: Men who are physically able to carry on with ordinary home duties and are particularly well in the climate and altitude of their home districts. They are able to stand work of a sedentary nature.

Unfit for any service: Men who are now physically unfit or might become unfit upon the slightest provocation.

[1] Presented before the Radiological Society of North America, at the Twenty-sixth Annual Meeting, Cleveland, Ohio, Dec. 2–6, 1940.

HEART EXAMINATION

The examination of the heart and great vessels is conducted with a view toward discovering congenital defects; hypertensive, arteriosclerotic, and aneurysmal lesions; also rheumatic, syphilitic, and thyrotoxic disabling conditions.

The pathological conditions of the heart and great vessels, while less frequently encountered in comparison with lung and pleural lesions, are nevertheless of great significance. The x-ray signs as revealed in the posterior-anterior flat film are often meager, and by the unwary radiologist may easily be missed. In no phase of the chest

A number of conditions other than disease may alter the "size and shape" shadow outlines of the heart:

(1) The large protuberant abdomen results in a high diaphragm with broad heart shadow.

(2) The short, thick build produces a general enlargement of the heart shadow due to the habitus and the greater distance between the heart and the film.

(3) Hyperexpansion during inspiration also increases the distance between the heart and the film, and the pulmonary artery shadow in particular
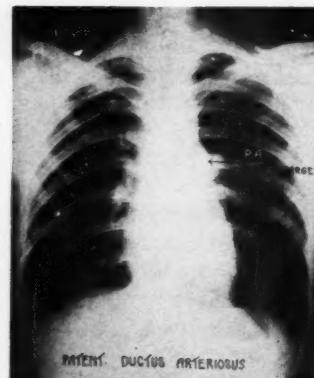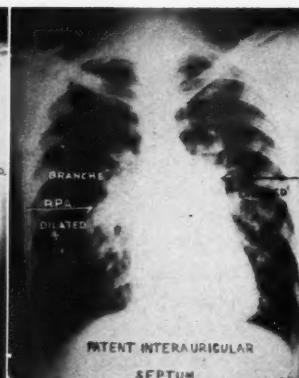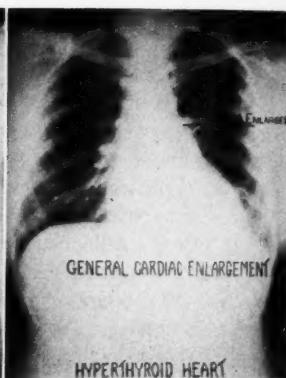

Fig. 1.   Fig. 2.   Fig. 3.

survey is it more essential for the radiologist to work hand in hand with the clinician. Not only should they study the doubtful heart films together, but they should "team up" in the fluoroscopic examination, for mutual understanding.

A great amount of discussion could ensue in regard to the size of the heart, if exact measurements were regarded necessary, but as we are concerned with approximate determinations, we can avoid controversy upon this point. For general purposes, we measure the greatest width of the heart shadow and compare this with the greatest inside transverse measurement of the thoracic osseous cage. If the heart is half the width of the chest, we regard it as within normal limits.

is enlarged, due to intrapulmonary circulatory tension.

(4) A depressed sternum results in compression of the heart with lateral spreading and displacement.

(5) Scoliosis results in heart displacement and rotation.

(6) Over-development of the muscles of one-half of the chest, often found in right-handed persons, may produce rotation of the heart with changes in shadow contour. A similar alteration in the heart shadow results from the incorrect positioning of the recruit in contact with the film cassette holder.

(7) Occupation and athletic training increase the size of the heart slightly.

(8) The pleuro - pericardial - diaphragmatic angle, filled by fat or adhesions often gives a false impression of increased cardiac size.

The heart lesions that may be encountered will be mentioned briefly, with notes as to their bearing on classification for service:

Patent Ductus Arteriosus (Fig. 1).— When the heart is not enlarged, and when the pulse pressure is found to be normal, one is led to believe that the leak between the aorta and the pulmonary artery is not very great. Patients with this condition would probably live for fifteen years before

is not directly due to thyrotoxicosis, but to heart muscle strain from the increased load of blood. Patients with heart complications associated with toxic thyroid disease are *unfit for any military service* because the added exertion and excitement would soon play havoc.

Syphilitic Aortitis (Fig. 4).—Syphilitic aortitis is frequently associated with sclerosis of the aortic valve, causing aortic regurgitation but not stenosis. There is loss of muscle tone in the vessel walls. In a fair percentage of the patients aneurysmal lesions develop (Fig. 5).

Aortitis when accompanied by aortic valve lesions usually results in complete
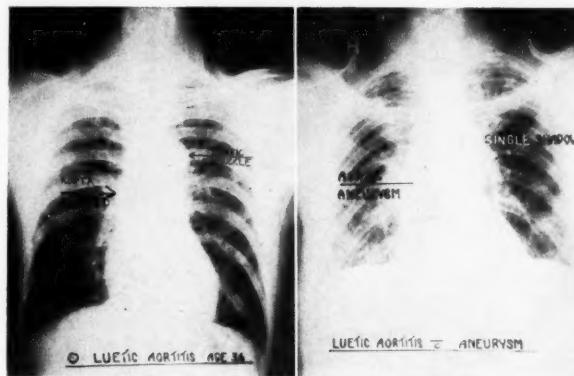
Fig. 4.   Fig. 5.

signs of failure. We would therefore place such recruits in the category *fit for service in Canada.*

Patent Interauricular Septum (Fig. 2).— Seldom is this abnormality in evidence until the late twenties or early thirties. In the late thirties, complete failure of the heart ensues. A small defect in the septum is fairly common; the large defect is not common. As a result of the large defect, the pulmonary circulation has a tremendously increased load. Such a lesion is considered serious and the recruit is classified as *unfit for any service.*

Hyperthyroid Heart (Fig. 3).—The toxic thyroid heart is "ham-shaped," the x-ray picture being similar to that in arteriovenous aneurysm. The heart enlargement

failure or death within four or five years after the diagnosis. Syphilitic blood-vessel disease classifies the recruit as *unfit for any service.*

Hypertension and Arteriosclerosis (Figs. 6 and 7).—In cases of arteriosclerosis of the aorta, the heart does not show evidence of failure until a late stage. Arteriosclerosis alone, without hypertension, may not be a serious malady, but there is always the underlying thought that there may be involvement of the walls of the coronary arteries. It is interesting to note that patients with arteriosclerosis who have, on occasion, had a slight degree of failure may regain their normal cardiovascular tone after prolonged rest, but the benefit is only transitory. The recruit with hyperten-
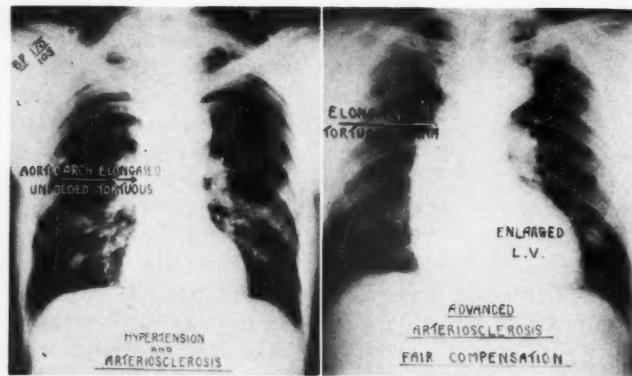
Fig. 6.   Fig. 7.
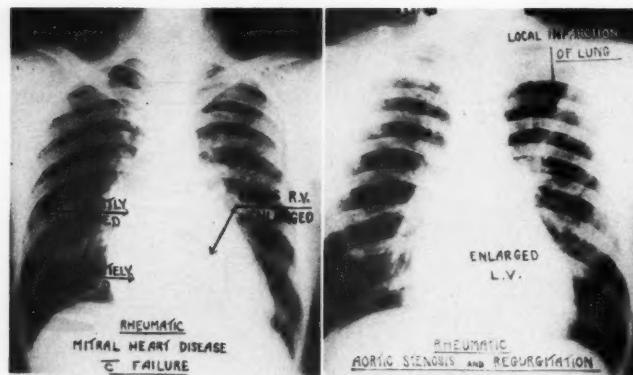
Fig. 8   Fig. 9.
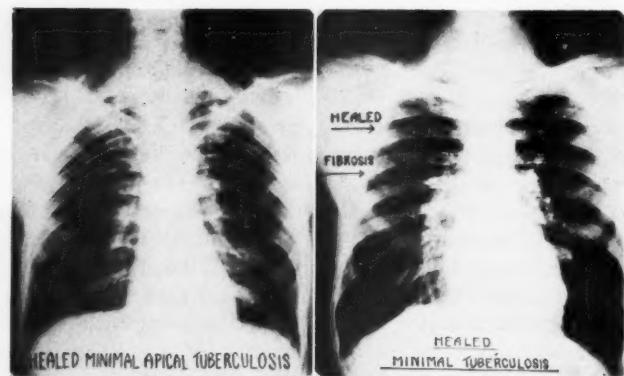


Fig. 10.   Fig. 11.

sion and/or arteriosclerosis is *unfit for any service.*

Rheumatic Mitral Valve Disease with Failure (Fig. 8).—Mitral valve disease is the most serious valvular lesion of the heart. With this disease the recruit is *unfit for any service.* In any cardiac lesion, one is frequently confronted with the necessity of determining the cardiac muscle tone—so-called exercise tolerance. The usual method of determining this by exercise is not very dependable. Impairment of cardiac muscle tone can best be determined by observing the degree of shortness of breath while a man is at his ordinary work. In addition, there is

sidered in this review. It is the minute active lesion and the so-called healed focus which require study.

Another condition which is giving the consultant board not a little trouble is the presence of chest shadows suggestive of low-grade infection, probably of upper respiratory origin. There is increased density in the peribronchial and perivascular tissues and also in the hilar regions. The parenchyma of the lungs exhibits mottling of varying degrees of density. Recruits showing such a picture seem never to be entirely free from colds, but are always either just recovering from, or developing a new cold.
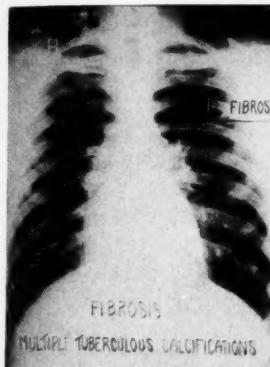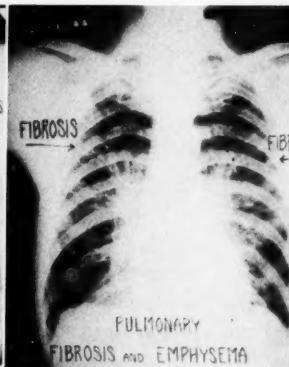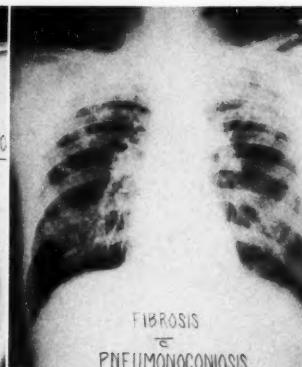
Fig. 12.   Fig. 13.   Fig. 14.

disturbed peripheral circulation as evidenced by dilatation of the jugular and antecubital veins. In the later stages there are congestion of the lungs, engorgement of the liver, and swelling of the ankles.

Rheumatic Aortic Stenosis and Regurgitation (Fig. 9).—This is a serious valve disease. Recruits with aortic regurgitation or stenosis are considered *unfit for any service.* The increased work required of the left ventricle inevitably results in failure with shortness of breath due to lung congestion.

LUNG EXAMINATION

The field of interest for the lung specialist and the radiologist is great indeed. Advanced lung lesions will not be con-

We are convinced that this type of recruit is subject to breakdown and have consistently considered men of this group as unfit at present, or fit for home service only, with the suggestion that they be reexamined in three to six months, hoping that if undermining factors are eliminated they may qualify for a higher category.

Healed Minimal Tuberculosis (Figs. 10 and 11).—The difficulty in cases of so-called healed minimal tuberculosis is to determine whether there is a focus in the lung not entirely healed, which may be lighted up under service conditions. Such a lesion occurring within the past five years will rule a man as *unfit for any service.* In a young man, under twenty-five years of age, such a lesion occurring at any

previous date will rule him *unfit for any service*. On the other hand, a man of forty to forty-five years of age, with no history of disability, nor close contact with tuberculosis, might be allowed service in Canada, or in lines of communication.

In cases where there are multiple calcifications and excessive strand-like shadow densities, one is never certain that the process is entirely quiescent. At any time the recruit may develop an infectious case of clinical tuberculosis. The majority of such subjects, therefore, are considered to be *unfit for active service*.

Pulmonary Fibrosis (Figs. 12 and 13).—Cases of extensive fibrosis, with or with-


Fig. 15.

out calcification, indicate previous pulmonary infection, possibly tuberculous. Usually, there are areas of lung collapse, resulting in bands of thickened tissue, coupled with areas of lessened density. These cases are serious because of the possibility of recurring infections complicated by pneumonia, and if there be any evidence of sepsis, the recruit is labelled *unfit for any service*.

Some recruits with fibrosis without impairment of function and no evidence of sepsis, may be classified as *fit for service in Canada*.

Fibrosis with pneumonoconiosis (Fig. 14) may be so excessive as to interfere with function, causing shortness of breath and cough. Military service is then contra-indicated, for each respiratory infection would tend to aggravate the symptoms. Since these cases require thorough study for the purpose of ruling out tuberculosis as a complicating factor, we usually advise sanatorium residence for the purpose of investigation.

These recruits are considered as *unfit for any service* until all the evidence has been collected. Even when the findings fail to disclose the presence of superimposed tuberculosis, the recruit should not be classified higher than *service in Canada*.

Chronic Bronchitis with Emphysema (Fig. 15).—This condition, usually found in patients approaching middle life, although it may occur in asthmatics at an earlier age, is manifested clinically by shortness of breath. The chest tends to be deep, the movements are somewhat limited, and there may be hyperresonance. The superficial cardiac dullness is diminished. Less than normal density of the lung fields is present, especially at the bases. The diaphragm tends to be depressed and the ribs horizontal. This condition limits activity. It increases with the years and frequently becomes associated with a non-tuberculous pulmonary infection. Such a condition is aggravated by extremes of climate and renders the recruit *unfit for military service*.

Healed Empyema (Figs. 16–18).—An empyema which has healed to the extent that there is no pus present but has resulted in a thickened pleura, may produce some degree of weakness and shortness of breath. There may be dullness and a few râles, also suppression of breath sounds. Unless the recruit has been able to carry on at ordinary work for the past four or five years, we consider him *unfit*. A person with thickened pleura, the result of empyema, without clinical signs of pulmonary disease, and with well demarcated shadows in the x-ray film, should be *fit for service in Canada*. A case of empyema in which there is basal fibrosis, which is evidence of a septic lung and is associated

with bronchiectasis, is a different story. Such a man is apt to have more or less persistent cough with expectoration. In addition to physical signs of thickened pleura and areas of râles, suggesting a septic process, there are apt to be shortness of breath upon exertion and a tendency to recurring respiratory infections. This condition tends to get worse with the years and, consequently, as time goes on, the soldier is likely to become disabled, and the disability to be attributed to military service. A man with this type of lesion is *unfit for any service*. A recruit with a history of empyema operated upon at least five years previously, with no record

and rightly so. His interpretive judgment is put to the test. It is for him to select, on the basis of the posterior-anterior films, those recruits who have normal chests and are fit for active service. It is for him to decide whether a special examination by a consultant in heart, lung, or surgical lesions of the chest is required. As a result of an oversight by the radiologist, the recruit may end in a military hospital and become a pensioner for life—a never-ending expense.

The successful business concern employs an auditor to check the work of the accounting department. Such an audit does not reflect upon the ability of the accoun-
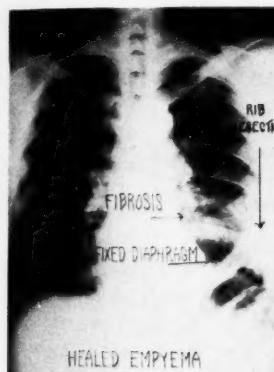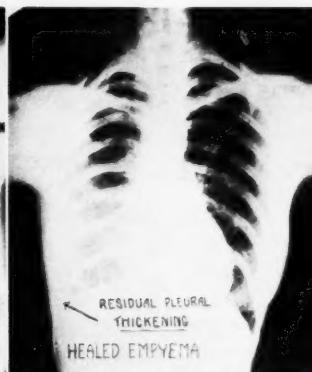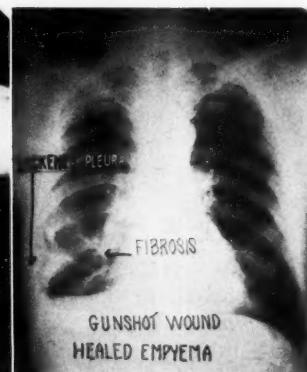
Fig. 16.   Fig. 17.   Fig. 18.

of subsequent lung disease, and apparently in good health, showing no loss of lung function and only a mildly thickened pleura, should be considered *fit for active service*.

Lung Tumor (Figs. 19 and 20).—In the presence of a lung tumor the physical findings and subjective symptoms may not be significant. Whether tumors are benign or malignant, they are considered as serious and the recruit is classified as *unfit for any service*.

COMMENTS

The responsibilities shouldered by the radiologist are great. He is one of the key men in determining the personnel of the Army, the Navy, and the Air Force,

tant. It is equally desirable to have a state or provincial radiologist consultant check the interpretations made by the examining radiologist. There is no reflection upon the local radiologist, but where there are several radiologists scattered at different centers, there are bound to be different opinions. Our records show that the consultant radiologist for Alberta discovered about one-half of one per cent of all the recruits considered as acceptable by the examining radiologists, to be unfit for service, and this opinion was concurred in by the consultant board of the province. Therefore, a consultant radiologist for the state or province, working in co-operation with the clinical consultants, is most advantageous; intui-

tively he builds up a shadow complex which spells normal or pathological.

This "fine-combing" of recruits may appear to be time-consuming and expensive, but as a matter of fact, it can be carried out expeditiously, and at little cost when compared with the charge upon the country if an unfit man is taken upon the "strength." Then again, it is a great sat-

mately 10,000 roentgenograms of recruits from the southern half of the Province of Alberta, which I have reviewed since the beginning of the present war. An attempt has been made to pass on the lessons learned from a clinical and radiological study of those who were considered to have roentgenologic evidence of abnormal chests.

Fig. 19.
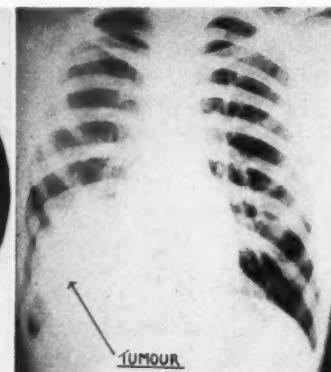
Fig. 20.

isfaction to the recruit to know his true physical status; he does not have the embarrassment of being a hindrance rather than a help toward the successful prosecution of the country's war effort. Also, he may avail himself of necessary immediate treatment and thus ward off advancement of his malady.

IN CONCLUSION

The material used in the preparation of this paper was selected from approxi-

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REMINISCENCES OF ROENTGENOLOGY DURING THE LAST WAR, 1917–1919[1]

REVIEW OF 17,000, EXAMINATIONS AND X-RAY EQUIPMENT EMPLOYED

By EDWIN C. ERNST, M.D., *St. Louis, Missouri*

Director of Department of Radiology, Barnard Free Skin and Cancer and DePaul Hospitals

THE unfortunate events which are taking place abroad have stimulated our national defense program to such an extent that this is perhaps an opportune time for reviewing World War number one experiences and the problems which we were forced to meet under the most difficult roentgenological conditions. It is to be regretted that "old man military roentgenology" had to be so rudely awakened after twenty-four years of peaceful slumber.

This report embodies the medical experiences of St. Louis Base Hospital No. 21 (Washington University Unit) after assuming the duties of the evacuated British General Hospital No. 12, at Rouen, France. Although the conclusions were crystallized under the stress of war conditions, nevertheless the original recommendations of 1917 and 1918 may be of interest to many who may be privileged in the near future to engage in similar activities.

Modified foreign body localization methods, roentgenologic procedures in the management of war-wounded, and combination floor trochoscopic and radiographic apparatus were described by me in a paper sent for publication to the *American Journal of Roentgenology* during the Christmas holidays of 1917, but this was, perhaps, lost during a period of unusually active submarine warfare and may today be deposited in Davy Jones' locker of the Atlantic. I will attempt to present these data, together with the original recommendations made in 1917 (recently resurrected from an old dust-laden army

trunk) relative to the scope and limitations of the unforseen problems of a British Base Hospital. When I use the term "x-ray plates," you will understand my reason for so doing, since films were an unknown quantity in our area.

A small group of the 1,000-bed hospital units can be seen in the foreground of the accompanying photograph (Fig. 1) taken from the famous Rouen, France, race-course grand-stand.

The x-ray department was indeed fortunate in being housed in portable wooden huts (Fig. 2) instead of tents. The x-ray equipment allotted to us, however, was limited to one 6-inch "Butts" x-ray coil, Zenith mercury gas interrupter, wooden x-ray tube holder, and table. The current was supplied by eight one-inch-square celluloid wet storage batteries and these were, in turn, charged several times a day by a small one-cylinder gasoline engine. Both the gasoline engine and the Macalaster Wiggin gas x-ray tube proved to be, at times, temperamental—either the gas engine wouldn't turn over or the x-ray tube became "cranky." The combined space of the eight small batteries was less than an average-size automobile battery of today.

The full output of this apparatus, except when the x-ray tube was very "soft," never registered beyond two milliamperes. For fluoroscopic work less than half of that amount was employed. Two milliamperes of current was the maximum output for radiographic work at 50 cm. focal plate distance, and the one-milliampere technic was limited to fluoroscopic observations. High-speed x-ray timers were not in vogue at this time for the required fifteen-second to two-minute exposures.

Fig. 1. Famous race course at Rouen, France, converted into hospital area. Hospital tents in the background are those of St. Louis U. S. Base Hospital, Unit 21. Occasion: Concert by Irving Berlin's band on their way to the battle front, playing "Alexander's Rag Time Band."
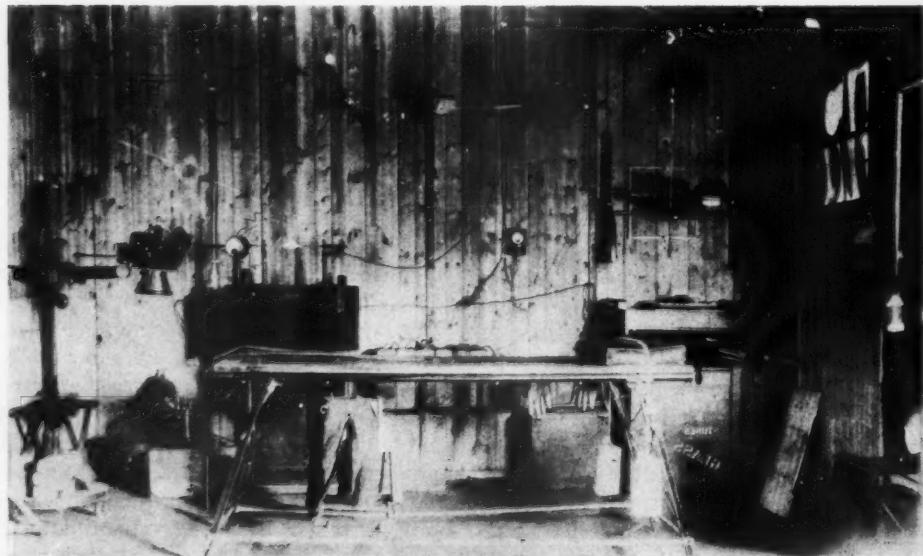
Fig. 2. X-ray department of British General No. 12 at Rouen, France. Butts x-ray coil; spark-gap; milliampere meter; voltmeter for testing batteries; mercury gas interrupter; gasoline engine and small dynamo for charging storage batteries; McKenzie Davidson Sweet localizer; gas x-ray tubes; wooden table and tube stand.

Direct or secondary x-ray protection with the above unit was practically nil (Fig. 2), and this accounts for the issuing of an official British communique advising the "radiographers" in the Rouen area at British base or mobile hospitals against the use of fluoroscopic procedures.

The administration of adequate medical attention to a large number of wounded stretcher cases during one of the periodic

was beyond the average safe body tolerance of the roentgenologist.

The necessary x-ray apparatus had been previously assembled in St. Louis, but remained in storage at home, since we were ordered to leave on short notice for the war zone early in April, 1917. For a time we "carried on" with whatever equipment had been allocated to us, or could be "wangled" from a supply depot.
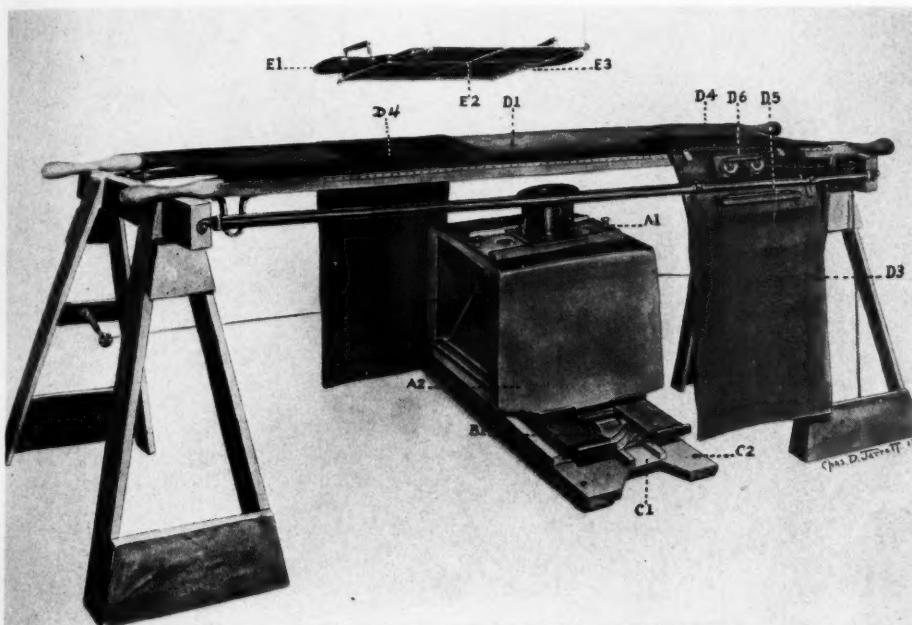
Fig. 3. Combination fluoroscopic, radiographic, and foreign body localization apparatus. Diaphragm openings of portable x-ray tube holder, *A1*. Left foot insert, *C1*. Lead sheeting, *A2*. Upper half of 10-cm. displacement apparatus, *B1*. Movable lead rubber apron, *D3*. Double throw switch for lights and fluoroscopic current, *D6*. Skin marking shelf, pencil, and ink, *D5*. Accessory flexible lead rubber protection flap, *D4*. Fluoroscopic screen, *E1*. Direct reading localization scale in centimeters upon fluorescent screen, *E3*.

German "putches" developed into a serious "rapid turn-over" problem which had to be solved, and directly involved the x-ray department. X-ray examinations, limited to radiographic plate studies, were too cumbersome and impractical. Every seriously wounded patient should, unquestionably, be examined roentgenologically at the earliest possible moment, preferably at a field or first-line base hospital. With the above described apparatus, however, the roentgen exposure to fluoroscopy

CLASSIFICATION OF PATIENTS

It soon became evident that early diagnosis in the case of the seriously wounded soldiers had to be expedited as much as possible after their arrival by ambulance or train from the battle zones of Ypres, Paschendal, Amiens, and Albert.

Preliminary rapid x-ray examination of the stretcher patients, depending upon the extent of their injuries, should, whenever possible, precede their tent bed assign-

ment. Day and night classification service of this type was therefore necessary during the stress periods; otherwise the hospital beds would become unnecessarily congested. Also, much suffering was avoided by examining the soldiers on their original ambulance stretchers, immediately upon arrival from the casualty clearing

(3) Trivial: trivially wounded soldiers, immediately rerouted to other hospitals.

(4) Non-operative cases. These were usually sent home to "Blighty," while the French and American soldiers were routed to the south of France.
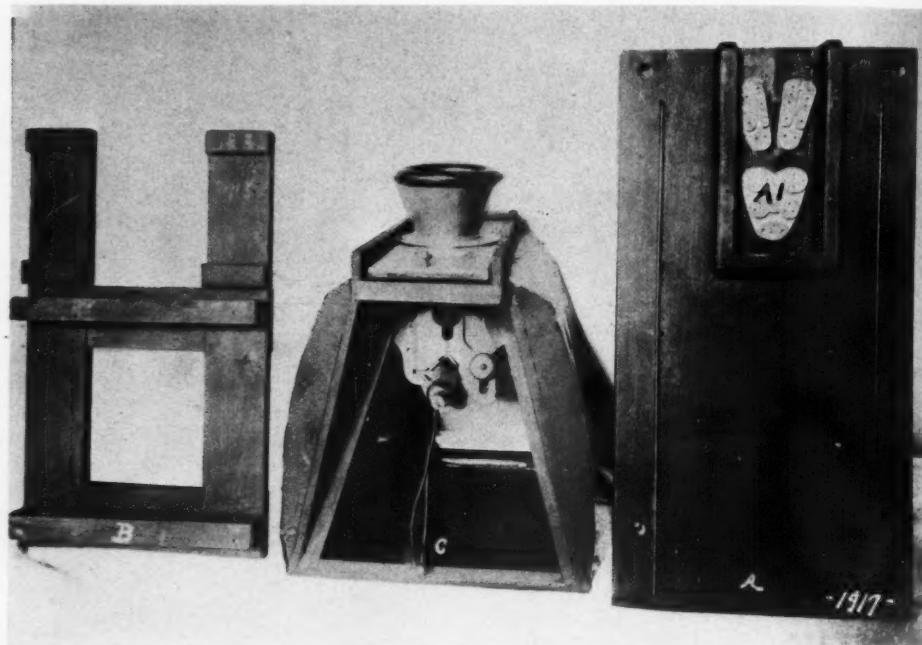
Fig. 4. Portable floor trochoscope: *A*, base rolls on floor beneath stretcher controlled by left foot of operator; *A1*, foot pads; *B*, middle section slides on the base *A*; *C*, upper compartment of tube holder and diaphragm firmly fixed to *B*. Both *B* and *C* units shift horizontally forward and backward 10 cm. on the base *A* for localization purposes only.

stations. However, safe fluoroscopic examination methods had to be devised if this problem were to be solved with the limited personnel and equipment available at British General No. 12. The ideal plan, therefore, was to classify all seriously wounded soldiers roentgenologically upon their arrival, as follows:

(1) Emergency cases: more seriously wounded soldiers requiring surgery, labeled "operation immediately."

(2) Less serious cases: requiring surgery at a later date, marked "defer operation."

FLUOROSCOPIC TECHNIC

To surmount our difficulties and add to the turn-over facilities of the hospital beds, a foot-controlled, roller-bearing, lead-lined tube holder (Fig. 3) was built with the aid of German carpenters from a neighboring prison camp. The very generous Royal Engineers of our area furnished me with the necessary lead sheet protection. A pair of wooden horses supported the stretcher, replacing the cumbersome x-ray table. Upon a metal rod between these wooden supports, a flexible lead apron was attached. Along the

upper margin of this lead apron, another flexible lead rubber strip was attached for protection from the direct rays of the x-ray tube and the indirect body radiations of the patient on the stretcher.

This added rubber protection (D^4, Fig. 3), when placed against the body in the region to be examined, served a most use-

structed (Fig. 4) and remained in service until the termination of the war. The base (A) was supported by four roller-bearing casters (Fig. 5) and could be rolled on any smooth surface beneath the stretcher with the left foot. Upon this base (B, Fig. 4) the upper section of the tube box could be made to shift horizontally to
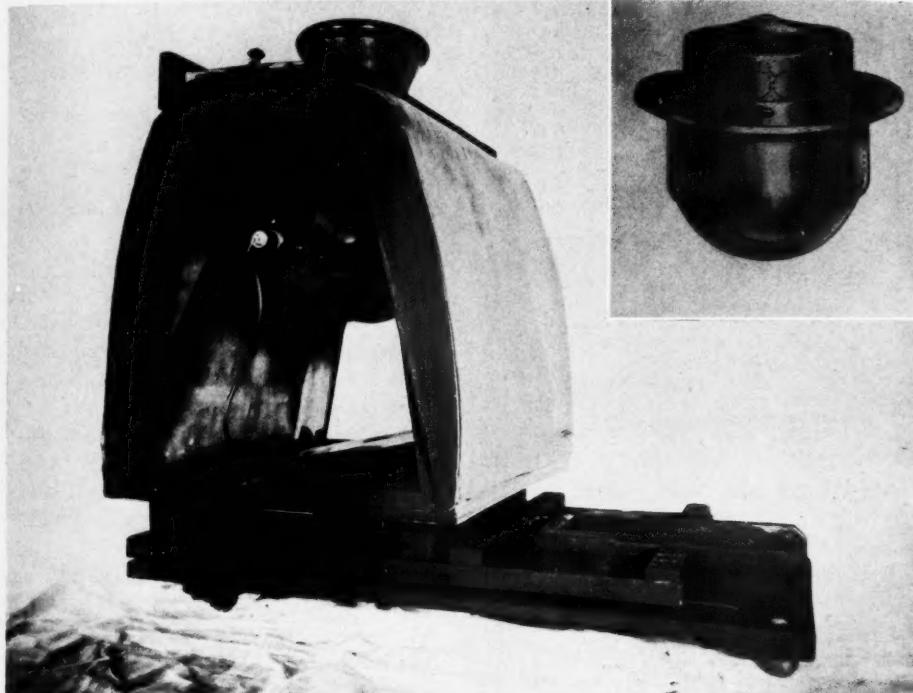
Figs. 5 and 6. Figure 5 (inset in upper right corner) is a large roller-bearing caster. Multiple smaller bearings facilitate free movements of the floor trochoscope in all directions. Figure 6 shows the complete floor unit when assembled, ready for use.

ful purpose by further eliminating direct and secondary radiations. From a personal standpoint, this added protection was greatly appreciated. Without it, serious consequences might have resulted to me in view of the large number of daily x-ray examinations. The fluoroscopic screen was suspended by counter weights as shown in Figure 3.

Since the problems of speed, efficiency, and protection appeared to be solved, an improved portable type tube box similar in design to the original was then con-

and fro, a distance of 10 cm.—no more and no less.

FOREIGN-BODY LOCALIZATIONS

During fluoroscopy both hands were free while the left foot guided the trochoscope beneath the stretcher. The roller-bearing casters facilitated the movements of this combination tube holder. When a localization was attempted, the 10-cm. shift came into play. The right foot fixed the lower base of the localization combination to the floor, while the left foot shifted

Fig. 8. Foreign-body depth scale computations in centimeters applicable for all distances between 45 and 60 cm. focal plate distance; especially adaptable for the radiographic double exposure localization plate or film technic. Milner formula (10-cm. tube shift). Calipers are useful as a measuring device.

Fig. 7. Schematic drawing of the modified single 10-cm. displacement localization method, applicable to fluoroscopy and radiography. Under fluoroscopic guidance the foreign body is centered opposite the first division of the scale at $X1$, by means of the floor trochoscope. The position of the right foot fixes the base to the floor (R), and the position of the left foot shifts the x-ray tube 10 cm. forward (L); the shadow is seen opposite the fourth division of the scale ($Y2$). The foreign body is localized to a depth of 4 cm. from the screen.

the upper carriage or tube holder a fixed distance of 10 cm., so that the time consumed for a localization was never more than two seconds. In Figure 6 the portable fluoroscopic tube unit is shown assembled ready for use.

In the early days of the war, we employed all of the known methods of foreign body localization, but finally concluded that the 10 cm. tube displacement shift was the most practical and useful method from the standpoint of simplicity, accuracy, and speed. The localization time is two seconds instead of one to ten minutes, usually required by more elaborate

methods. The relationship of the metallic fragment to a bony landmark near the area to be examined is greatly facilitated by this method of localization. Thus, the procedure assumes greater flexibility and helpfulness to the surgeon, when two exposures are made on a single plate for localization and the relative depths of the foreign body and the bony landmark can be compared.

The schematic drawing (Fig. 7) indicates the relatively simple (fluoroscopic or radiographic) technical factors of the 10-cm. tube shift method in localizing a diagrammatic foreign body. The bullet, designated as X^2, is placed opposite the first division of the scale and the second shadow, marked Y^2, shows the bullet after a horizontal shift of 10 cm.; thus the depth of the foreign body is determined as being 4 cm. beneath the skin.

If a double exposure is made, employing the same shift of 10 cm., the separation of the two foreign bodies is measured on the x-ray plate and the depth read directly from the graduate scale (Fig. 8). Other gradations are made for different target skin distances ranging from 45 to 60 cm. on the same scale. Routinely, however, we employed a focal plate distance of 50 cm. except when large patients were being examined.
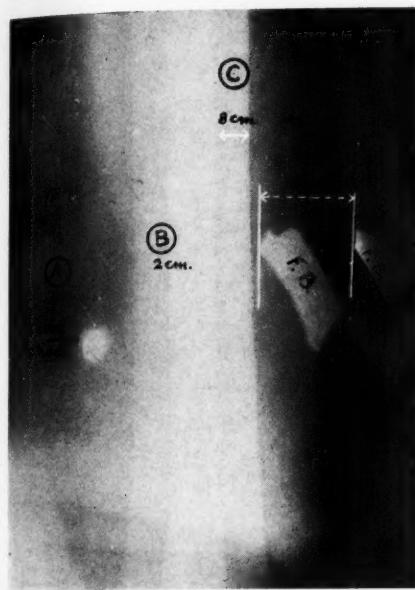
Fig. 9.   Double exposure plate of upper femur.
Question of fracture or foreign body.   The metallic
fragment shift is 15 cm., while the separation of
the edges of the femur is but 8 cm., indicating that
the foreign body is posterior to the shaft of the
bone.   The skin marker over the anterior wound
shows a 2 cm. shift; therefore the metallic frag-
ment is 13 cm. beneath the entrance wound and
behind the femur.

Fig. 10.   Double exposure on a single plate.
Since the metallic fragment separation is less
than the marginal shift of the lesser trochanter,
the foreign body is localized anterior to this
bony landmark of the femur.   The depth of
the metallic fragment from the anterior skin
mark can also be determined with accuracy from
scale (Fig. 8).

The double exposure, single plate technic
(Fig. 9) accurately pictures the depth and
relative position of the foreign body.   The
shrapnel fragment appears to be behind
the femur, since the shift of the bone is
less than the foreign body spacing.   The
surgical approach is thereby facilitated.

In Figure 10 the degree of separation of
the small metallic fragment is less than
half of the apparent marginal shift of the
lesser trochanter of the femur, and the
foreign body can therefore be reached
through an anterior opening, although the
wound entrance was posterior to the hip
joint.

RADIOGRAPHIC TECHNIC

All of our routine radiographs were
made with the x-ray tube beneath the
stretcher, and it was our observation that
equally satisfactory x-ray plates were ob-
tained with the tube below the patient

when facilitated by the use of focal plate
distance boards (Fig. 11) for supporting
the x-ray plate or screen.

Furthermore, several times as many
stretcher cases can be examined by the
combined fluoroscopic and radiographic
procedure with the trochoscopic tube
beneath the patient than by any other
method, including the overhead tube ar-
rangement.   The parts to be radiographed
are first visualized fluoroscopically, and
the diaphragm is then "coned down" to
conform with the area to be examined,
thus reducing secondary radiations to a
minimum.   The x-ray plate, or casette,
rests upon the focal plate board above the
parts under consideration.   Many un-
necessary technical movements and pro-
cedures are thereby eliminated.   The flex-
ible lead apron flap (D^4, Fig. 11) again
comes into play when placed against the
focal plate boards for the added protec-
tion of the operator.

Early morning localizations (Fig. 12)
were frequently required during an active
period of the war when the concrete pill-
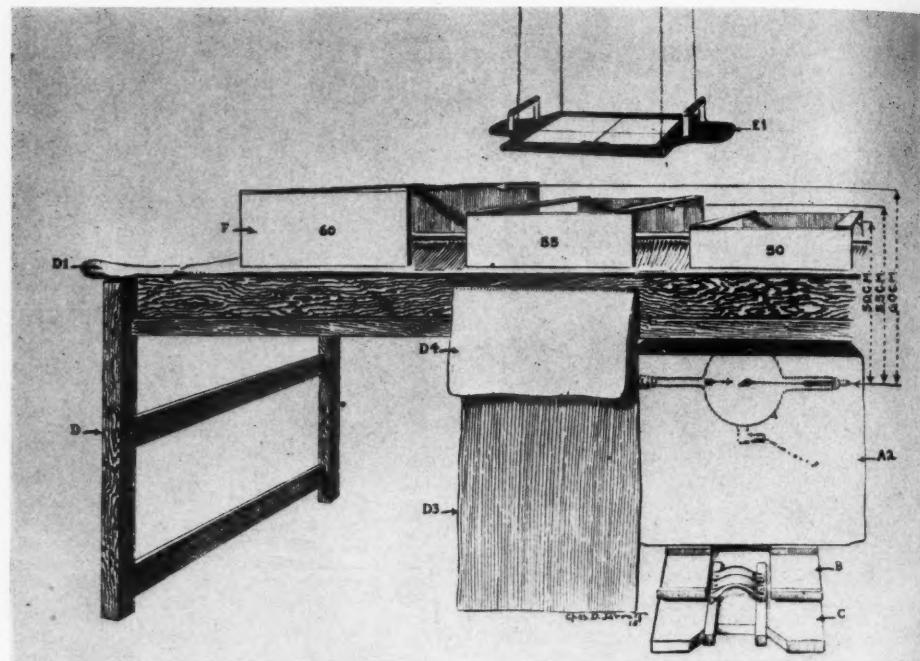
Fig. 11.   Focal skin plate or casette holders for double exposure localization or radiographic examination technic when the floor trochoscope is employed.   For convenience 50–55–60-cm. focal plate distances are employed.

Fig. 12.   Fluoroscopic localizations with the floor trochoscope—"premier" tryout.   Time 3:00 A.M.

Fig. 13.   Facsimile of the routine x-ray report and recommendations.

Fig. 14.   Facsimile of a page from the record book containing the x-ray findings of 17,000 fluoroscopic and radiographic examinations made in Rouen, France, 1917 and 1918.

Fig. 15. Lateral view of the skull showing rifle bullet near the occipital region. The bullet entered the mouth but failed to injure any of the vital throat and neck structures. Foreign body was localized relatively superficially.

Fig. 17. Large shell fragment and soft tissue abscess. No visible lung injury. Uneventful recovery.

Fig. 16. Through-and-through shoulder entrance wound shattering the head of the humerus. No foreign body found. Prognosis bad.

Fig. 18. Rifle bullet anterior to the cervical spine region. Originally entered the opposite left thorax, penetrating the lung and puncturing the trachea and (?) esophagus. Empyema. The soft parts of the neck show air infiltrations. Fatal termination.

boxes of the Germans contributed to a new phase and type of war injuries and conditions. During these emergency periods, night resting was abandoned and sleep was limited to between 6:00 A.M. and 12 noon, since the convoys of recently wounded soldiers usually arrived at night and during the early morning hours.

The facsimile report reproduced in Figure 13 indicates our method of recording cases, including the diagnosis and conclusion, with addition of our comments, such as—"urgent operation," etc. This report was pinned to the tunic of the soldier and the findings were reviewed by the attending surgeon and internist in an ad-joining operating room for final disposition. Figure 14 shows a page from our book of 17,000 examination records, giving the name of the soldier, his army number, regiment, parts to be examined, and the x-ray findings.

A few case reports selected from a group of 500 x-ray plates, which I fortunately brought with me when we were ordered home in May of 1919, may perhaps be of interest to illustrate the basis for some of our conclusions.

ILLUSTRATIVE CASES

Figure 15 shows a rifle bullet localized external to and beneath the occipital skull.
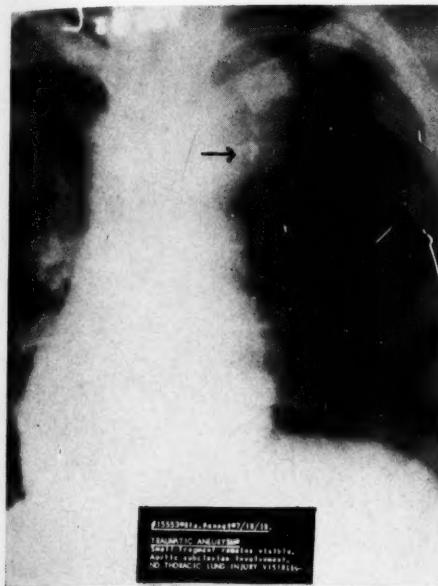
Fig. 19. Traumatic aneurysm. The small metallic fragment was localized within the wall of the aneurysm.
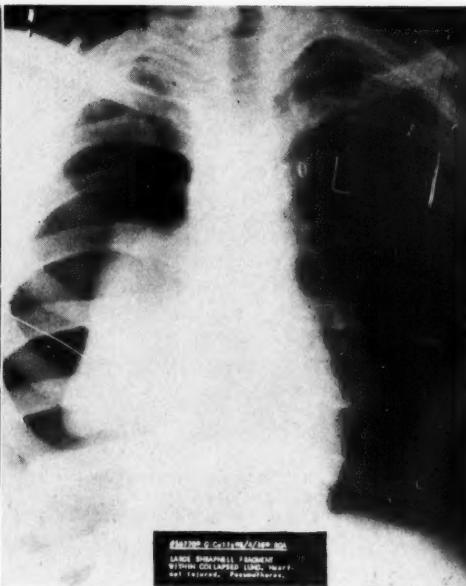
Fig. 20. Collapsed right lung.   Pneumothorax. Fractured ninth rib at point of the wound entrance. Absence of foreign body.   Transferred.

This bullet entered the mouth and passed around the neck structures and failed to traumatize seriously either the organs, nerves, or vascular structures.   Even inflammatory sequelae failed to follow this unusual injury.

The right shoulder joint shown in Figure 16 presents a through-and-through shrapnel wound, completely crushing the head of the humerus.   A few of the fragments were found along the opening of the exit wound.   Immediate surgical drainage and transportation to a permanent hospital were advised.

The left supraclavicular area in Figure 17 shows evidence of a large shell fragment surrounded by a huge abscess cavity. Note the absence of lung involvement. Immediate extraction of the foreign body and surgical drainage was the only course.

The rifle bullet shown in Figure 18 was localized several centimeters beneath the skin, but unfortunately the lung had been penetrated.   Air can also be observed between the soft parts and muscles of the neck.   The esophagus had been ruptured.

Immediate operative procedures failed to save the life of this unfortunate victim.

The traumatic aneurysm shown in Figure 19, and the small metallic fragment, prognosticate the probable sequence of events.   Localization clearly indicated the position of this small bit of shrapnel within the wall of the aorta, and "immediate hospitalization and rest" were indicated to await nature's healing skill.

Figure 20 is from a case of through-and-through lower thoracic chest wound resulting in the collapse of the right lung and accompanying pneumothorax.   There was an absence of a possible metallic fragment.   Temporary surgical measures and transportation home were advised as soon as the physical condition would permit traveling.

Figures 21 and 22 show crushing injuries to the soft parts of the shoulder joint and shafts of the femur.   In addition there are evidences of multiple small shrapnel fragments and bismuth paste opacities.   This latter paste, nicknamed "Bip," was placed in the open wound
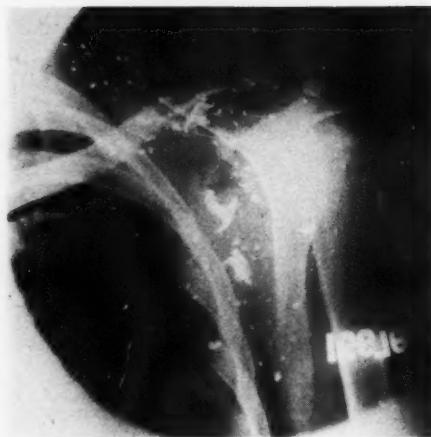
Fig. 21. Right shoulder joint shrapnel injury. Bismuth iodoform paraffin ("Bip") paste injected into the wound entrance. Very confusing from a localization standpoint.

at the field dressing station. The unfortunate soldier was then immediately evacuated to another hospital. This practice was finally discontinued since it merely added complications, especially for the roentgenologist. Attempting to localize foreign bodies that might be present was an almost impossible task. Such a wound was difficult to cleanse or drain, and extensive surgical incision was the only recourse. These cases could be classed as "indeterminates" from a roentgenologic standpoint, although most of these "Bip" wounds remained infected, notwithstanding the antiseptic feature of bismuth and iodoform.

A large shrapnel fragment observed fluoroscopically in the soft parts of the right jaw is shown in Figure 23. Both sides of the face were swollen. The entrance wound was on the right side. The double-exposure, lateral radiograph of the skull indicated that the metallic fragment shifted but one eighth of an inch in the second exposure on the same plate. The measurement of this shift with calipers indicates, from the scale (Fig. 8), that the depth is 1 cm. beneath the skin. The metallic fragment was easily removed, the wound drained, and "Tommy" was sent on his way to "Blighty."

Fig. 22. Shrapnel injury. Shattered bone fragments. Multiple smaller metallic fragments and bismuth iodoform paraffin paste ("Bip").
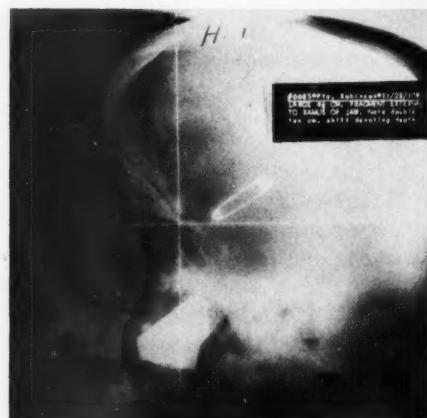
Fig. 23. Large metallic shrapnel fragment localized external to the ramus of the left mandible 1 cm. beneath the skin as shown by the one-eighth inch shift, computed at a glance (Fig. 8).

The rifle bullet shown in Figure 24 was fluoroscopically localized between the ends of the fractured humerus, since it was observed that the ends of the shaft fragments "drifted" alike during the 10-cm. shift of the foot fluoroscope. An actual centi-
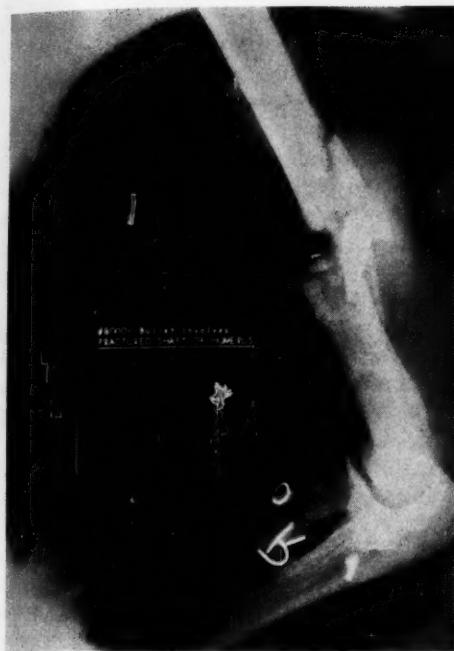
Fig. 24. "Spent" rifle bullet between the fragments of the humerus.

Fig. 25. Left knee joint fragments posterior to the tibia, complicated by gas-bacillus infection. Trauma occurred one hour preceding the Armistice. Fatal termination.

meter depth localization of the bullet was superfluous.

The left knee joint condition shown in Figure 25 was, indeed, unfortunate. Two small shrapnel fragments could be visualized anterior to the tibia, but the soft parts indicated "gas bacillus infection." The luckless "Tommy" was wounded, or "nipped" as he put it, one hour prior to the Armistice. He celebrated the termination of hostilities that night, but the third day complained of pain. His wound had been dressed at the mobile hospital. No doubt if portable x-ray equipment had been available, the foreign bodies removed, and the wound drained, at the field or casualty clearing hospital, the life of this unfortunate boy might have been spared.

COMMENTS

It must be kept in mind that in the casualty clearing or mobile field hospital zones, the roentgenologic requirements differ from those prevailing at a permanent base hospital. Extreme accuracy with elaborate localization equipment must be sacrificed for speed and practicability, so essential in the field. The advantages of portable x-ray equipment in the more active war areas should be recognized. This would be true, also, in "total war" conditions.

Although we routinely employed the single tube shift for the indirect localization of foreign bodies, nevertheless, approximately fifty per cent of our localizations were accomplished by simpler procedures.

1. When the foreign body is examined in soft tissue structures, or muscles, near the surface of the skin, direct pressure and movement of the foreign body under fluoroscopic control are invaluable for direct localization.

2. On the other hand, if the foreign body is observed three or four centimeters

internal to the lateral walls of the body or extremities, and a metallic rod (preferably marking pencil) is placed, externally, at the level of the foreign body, both the metallic fragment and the metal pointer shift equally when the x-ray beam is directed to and fro. The skin is then marked at that point to denote the level or depth of the foreign body.

3. The two-plane plate examination (anterior-posterior and lateral 90 degree views) is a valuable procedure, but from a surgical point of view, this radiographic method is frequently less informative unless at least four skin areas are accurately marked at opposite right angles to the skin.

4. In selected cases the Sutton cannula and trocar harpoon were successfully employed. The buttock especially was a favorite site for the introduction of a wire direct to the foreign body.

5. The direct removal of foreign bodies under fluoroscopic guidance was an ideal procedure in a limited number of cases.

6. Many other relatively simple methods had to be devised, especially in "roving" foreign bodies of the thorax.

Above all, the surgical approach for the removal of metallic fragments must be continually kept in mind, or anticipated, by the radiologist in the more difficult localization examinations.

CONCLUSIONS

From the standpoint of practicability, accuracy, speed, protection, localization, and adaptability to the many unusual roentgenological requirements of a base hospital, the home-made trochoscopic apparatus described, in our experience equalled the performance of the more complicated hospital table equipment; the latter lacks the advantages of portability and simplicity of the former for active war service.

During the later stages of the war, we attempted to work with various conventional and special diagnostic and localization x-ray table combinations, but found them more or less impracticable for the type of emergency radiologic service demanded by an active evacuation hospital unit.

RECOMMENDATIONS

1. Portable x-ray units, simple in design, are prerequisites for the rapid "turn-over" of wounded at a mobile hospital.

2. Localization apparatus should be easily manipulated with a minimum amount of mathematical computation.

3. Patients should be examined directly on the stretcher whenever possible; fluorosopic methods are ideal for obtaining the desired amount of preliminary information.

4. The overhead x-ray tube at a field hospital, or mobile base hospital, is an unnecessary luxury.

5. Any one of several combination x-ray tube and transformer (single-head type) units can be employed in a floor type of trochoscope of 15 to 30 milliampere capacity for both fluoroscopic and radiographic examinations. The 100- to 115-volt current can be supplied either by conventional lighting circuits or connection with a 3,000-watt capacity gasoline engine motor generator set. It is our opinion that high-tension shock-proof cables and porcelain bushings should be eliminated whenever possible in the design of any x-ray unit for field service.

6. Simplicity of any formula or method of localization should be the rule rather than the exception.

DISCUSSION OF SYMPOSIUM ON RADIOLOGY IN WAR

DR. JAMES T. CASE (Chicago, Illinois): All of us who had some part in World War No. 1 feel a rather intensified sense of fellowship and satisfaction that we have had some experience which may perhaps be of service in the new emergencies.

We have heard from all the speakers a very well rounded program, enlightening us as to what is being done and what needs to be done by the military and naval establishments. And the reminiscences of

Dr. Ernst bring back to many of us vivid memories of 1917–1918.

I want to emphasize what has been stressed by all of the speakers, that the most important requisite for an adequate radiological service in any of these branches of the national defense establishment is a well qualified radiological staff, well trained and carefully supervised. It is obvious that an order designating a medical officer as in charge of a radiological service does not endow him with the necessary qualifications. I am already seeing examples of this in connection with appeals for my help to correct erroneous interpretations.

During the last war, as Chief of the X-Ray Service of the American Expeditionary Forces, I was in a position to see some far-reaching effects of inadequate service when certain men not properly qualified undertook to make fluoroscopic and film readings upon which so much depended. On one occasion, I learned that an alarming number of men were being returned to the United States with a diagnosis of pulmonary tuberculosis, but that when these soldiers reached home they were found not to have the disease. On investigation it was found that a certain radiologist in an important post was reading too much into x-ray films. No doubt it will be seen to by those in authority that the officers to whom is entrusted this matter of interpretation of x-ray films shall be qualified and experienced men. This applies particularly to the examination of the chest. It is impossible to take a man directly from civil life and put him into military radiology. He must have special training.

In the Veterans' Administration I have seen much pulmonary tuberculosis alleged to have been contracted during the War as a service disability, where the contrary could not be proved because film records prior to service were not available. Many such possibilities will be eradicated by the scheme of having all recruits subjected to x-ray study of the chest.

Dr. McGuffin's remarks afford us a little more knowledge on some of the applications of military radiology in the examination of recruits. His very practical paper will doubtless receive much study. His experience is valuable.

Dr. Ernst's demonstration is especially valuable as emphasizing one other point which I believe deserves emphasis. Methods of localization of foreign bodies must be simple. There is no necessity for complicated measures for these localizations, and Dr. Ernst has shown you how simply he did them. Major de Lorimier also showed that the method is going to be very simple with the present newly perfected apparatus.

I wonder how many appreciated what Dr. Ernst said about his old gas tube becoming too hard and about having to soften it. With us, a mere turn of a button to change the number of amperes of the filament current is automatic, like putting a foot on the brake when we want to stop a car. I dare say there are a good many in this room who never had the pleasure nor the sweat of working with gas tubes. Dr. Ernst had about the same general experience as all of us who used the gas tubes; if we got one milliampere of current, we were doing pretty well.

In regard to mass x-ray study of the chest, there is the great danger of excluding fit men by having the interpretations made by physicians who are not really prepared to read chest films.

The present-day surgeon, in general, lacks appreciation of the value of x-ray help in extraction of foreign bodies and methods of localization. The surgeons who had that experience in the last war have retired or are getting near retirement age and the younger men who have come in have not been trained in the simple methods of localization.

I am glad to see that the defense plan includes radiotherapy, and that Major de Lorimier seems to be tolerant of the idea of x-ray treatment of gas bacillus infection, and perhaps also of other infections. I am personally thoroughly convinced that the x-ray treatment of gas gangrene is important.

Dr. E. H. Skinner (Kansas City, Mo.): I believe that the experience of the British radiologists may be of interest in this connection, Dr. A. E. Barclay, Oxford, head of the Radiological Department for the Ministry of Health in England, writes that except for two or three days a week, when he gets up to London, he is off around the country seeing that x-ray work is going on satisfactorily in the provinces. The London hospitals are, of course, reduced to first-aid stations and evacuate their cases as soon as practical to emergency service hospitals in the country. The x-ray work Dr. Barclay describes as of the simplest type, the cases being mostly fractures, which can be just as well interpreted by the surgeon as by the radiologist.

Few chest and abdominal wounds are seen by the radiologist as most of such patients are treated for shock and rushed straight to the operating theater.

Dr. Barclay expresses great concern for the future of diagnostic radiology, as he believes the war will accelerate the tendency of the clinicians to do more and more of their own interpretations, while public institutions will offer increasing competition to the private radiologist. Unless such institutions can give sufficient compensation to attract competent radiologists, only those of second rate will devote themselves to this branch of medicine, which perhaps more than any other needs men of the highest caliber.

In another letter, to Dr. Tovell of Toronto, Dr. Barclay speaks of the number of gastro-intestinal cases, including a considerable proportion of ulcers, seen after the return, in March, of the convoys from France to clear the hospitals there. The mobile units designed for work in emergency cases were of little use under these conditions and, since transfer of the men to suitably equipped hospitals was out of the question, as many units as possible had to be hastily raised and placed strategically. Again after Dunkirk the mobile units proved impracticable and more and more portable units have been installed, while still more are being ordered.

Dr. David E. Ehrlich (Brooklyn, N. Y.): In line with the theme of the preceding papers, I wish to make a preliminary report of the x-ray examination of draftees at the induction centers in New York City.

The Health Department of the City of New York volunteered its services, which were accepted by the Army, for this purpose. On Nov. 18, the Draft Boards began work, and on Nov. 25 the induction centers started their work. Four induction centers took care of the city and the southern counties of the state. In each center was a portable unit. The roll paper method was used.

Every draftee was x-rayed, a total of 2,060 men. Of that group, 45 were called in or rejected for service. Of these 18, or 0.9 per cent of the total number examined, had active tuberculosis; 15 or 0.7 per cent had arrested tuberculosis, and 12, or 0.6 per cent, were what we called suspects.

This is, of course, a preliminary report. Some of these men may still go back into the service, but at the present time 45, or 2.2 per cent, of a total of 2,060 men have been rejected.

Dr. Carleton B. Peirce (Montreal, Canada): Dr. McGuffin unfortunately did not have an opportunity and I think feels just a little reticent about discussing the Canadian method of examining recruits, which I feel I can do with a little more freedom inasmuch as I am still an American, although very much a Canadian in sympathy.

The Director General of Medical Services, in October, 1939, shortly after the war started, sent his Consultant Radiologist about the country to discuss the chest survey with the radiologists. As a result, the members of the Canadian Association of Radiologists and a few other physicians, who in the opinion of Colonel Jones and the members of the Association in the particular military district were qualified to read chest roentgenograms, undertook the survey of the entire military establishment. The radiologists volun-

teered their services but were paid by the Government a small sum for examination, which covered the cost of materials and additional non-professional labor required.

In less than two months, the chests of all the active service force units then mobilized had been examined. The films had been reported upon by the individual radiologist in the community or district mobilization center, and those approved by him had been forwarded to Ottawa, and had been finally reviewed there by a board of radiologists. Questions of policy as to what variations or lesions should constitute grounds for disqualification were settled in Ottawa by the Consultant Radiologist with the advice of his fellow radiologists. That program is still being carried out with new recruits and units.

From university student surveys and our recent experience, I anticipate that between 0.5 and 2.0 per cent of the men will have active pulmonary tuberculosis not discovered on clinical examination by their local boards, and approximately 10 per cent will be remanded to special boards because of abnormalities discovered on chest roentgenograms.

I have been interested to hear of the estimated economy and the dependability of the photoroentgenographic method for the military personnel. I question if the cost of transporting men to reception centers where the special apparatus is to be installed (when and if manufactured), maintaining and transporting them home again, plus the cost of the special equipment and its operation, can be as little as one-fiftieth of the expense of full 14 × 17 chest films at or near the trainee's home. That is an exercise in cost-accounting which I am not yet able to fathom.

Furthermore, I wonder if the services charged with these examinations have enough qualified roentgenologists who are familiar with the miniature film to select adequately the trainees who are to be approved or to be discharged. In comparison I believe the method used in Canada has not only been most satisfactory and altogether economical, but above all it has made use of the talent of all qualified roentgenologists of the country.

DR. FREDERICK O. COE (Washington, D. C.): I will not discuss the papers, but merely call attention to a few things that are important to our younger men, who fall within the draft age.

At the present time a doctor will be drafted just the same as anyone else. It is very important that those who are Fellows or who have had training in radiology send in their questionnaires to the American Medical Association so that they will be listed in the special service board that has been set up. In case they are drafted and called in service, they should get in touch with their corps officer immediately, and at the same time inform the committee of the American Medical Association of their special training, so that, just as quickly as possible, they will be shifted into the service for which they are trained.

It is important to get the radiologist into the position where he belongs. All of you know that the men who served during the last war are now almost exclusively lieutenant colonels. In case of declaration of war, these men will become colonels or something higher, and no longer do any radiological work. They become desk men after that. This leaves the entire radiology of an army at war almost exclusively in the hands of us, the radiologists of the country; either we will have to volunteer or some plan must be made that we may be used.

As for training of radiologists in the army, that has not yet been worked out. An endeavor is being made to formulate a workable plan. The suggestion has been made that young men be commissioned as first lieutenants in the Army and be sent, preliminarily, to the Army Medical School and later farmed out to radiological departments where they can receive adequate training.

CAPTAIN LUTHER SHELDON, JR. (closing): I should like to say in regard to the

35-millimeter film which we are using in the Navy, and intend to use on a much larger scale, that it is very simple. The apparatus we are using is one that has been manufactured in the Navy Medical School in Washington and which may be duplicated at any Navy Yard or aboard any larger ship which has a machine shop.

The main feature is a lead-lined cone with a fluoroscopic screen at one end and an ordinary 35-millimeter Leica camera built into the other end. The pictures which we have made have been very satisfactory, using 150 milliamperes at a distance of 38 inches. To illustrate the ease with which they may be read, we had one roll of 128 single pictures read by a man who had never before seen a 35-millimeter chest film; out of this group of 128 there was just one minimal tuberculous lesion, and the doctor was perfectly able to pick that out of the entire number. We feel, therefore, that the method is going to be both satisfactory and inexpensive.

MAJOR ALFRED A. DE LORIMIER (*closing*): I should simply like to add a verbal salute for the interest expressed by the several discussants. The patriotic interest that has been shown is very stimulating. Actually it has been surprising to me to receive so many letters from all parts of the country, offering keen and conscientious suggestions.

As regards the comments by Dr. Case, I would like to say that the Army is depending upon the recommendations of the American Medical Association and in particular the subcommittee on Radiology. We shall have great need for radiologists.

As regards the caliber of radiologists, we expect to recognize the credentials of the American Board of Radiology, membership in the American Roentgen Ray Society, and membership in the Radiological Society of North America. In addition, we expect that, regardless of these qualifications, it will be necessary to offer a short course at the Army Medical School,

a course of perhaps two weeks to a month, in order to discuss, in particular, foreign body localizations and adaptations for field activities.

I hope that the map that was shown outlining the relative positions of the mobile surgical hospital, the evacuation hospital, and the general hospital will not be taken too literally. It showed merely rough relationships.

I am of the opinion that since so much fluoroscopy will probably be needed rather than roentgenography, we shall require the services of radiologists.

DR. EDWIN C. ERNST (*closing*): In closing I merely wish to reemphasize the theme of my presentation, namely, that serious consideration should be directed toward thorough training of the personnel and the critical selection of the x-ray equipment for effectively supplying the different needs of future "total war" conditions. Easy mobility and extreme simplicity of apparatus with increased flexibility of adaptation are the immediate urgent needs, both from an economical as well as military efficiency standpoint.

The home-made apparatus (model 1917 trochoscope) and the simplified localization and radiographic methods described can, in my opinion, be modified to meet most of the probable future mobile x-ray equipment demands. The x-ray gas tube and coil can be replaced by respectively 10, 20, or 30 ma. combination oil-immersed x-ray tube transformer units, with dual low-tension current connections for either the average 110-volt lighting current or standard portable gasoline motor generator sets. The overhead x-ray tube is not only an unnecessary luxury for radiographic work, but may be a handicap as to mobility and practicability over features found in the less complicated and lighter equipment.

The probability of x-ray treatment for inflammatory therapy problems should be given equal consideration at mobile base hospital centers, in which event, both types of equipment may be desirable.

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ROENTGEN MANIFESTATIONS OF ARTERIOSCLEROSIS OF THE BRANCHES OF THE ABDOMINAL AORTA[1]

WITH PARTICULAR REFERENCE TO CALCIFICATION OF BRANCHES OF THE COELIAC AXIS

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MUCH has been written about calcification of the walls of the abdominal aorta and every roentgenologist has numerous opportunities to see calcified plaques in this location. Calcification of individual arterial branches of the aorta has been described less frequently and there have been occasional reports of aneurysms of the splenic and renal arteries with calcified walls. Practically nothing appears in the current roentgen literature, however, concerning mass calcification of a group of arteries, such as the branches of the coeliac axis, with the production of confusing shadows overlying the left upper quadrant. The distinction between simple arteriosclerotic calcification of the arterial wall and aneurysm is usually not clear. It is the purpose of the present paper to show how varied the roentgen picture may be, and to suggest the means by which a correct diagnosis may be made.

The visceral branches of the abdominal aorta are as follows: (1) a single coeliac axis arising at the level of the dorsolumbar junction immediately below the aortic hiatus of the diaphragm; this trunk is very short, 1.0–1.5 cm. in length, dividing to form the left gastric, the hepatic, and the splenic arteries; (2) superior mesenteric, a single vessel arising 1.2 cm. below the coeliac axis, serving all the small intestine and the proximal half of the colon; (3) inferior mesenteric, a single vessel arising from the aorta anteriorly at the level of L-3, serving the rest of the colon and most of the rectum; (4) paired suprarenal arteries arising at the same level as the

superior mesenteric; (5) paired renal arteries with short trunks which lie directly below the superior mesenteric, arising at the level of L-1, or L-2; (6) internal spermatic (or ovarian) arteries, paired slender vessels arising a short distance below the renal arteries, midway between the origin of the superior and inferior mesenterics, passing obliquely downward, resting on the psoas muscles, to reach the abdominal inguinal ring. There are also parietal branches, such as the four pairs of lumbars, and occasionally additional branches such as the paired inferior phrenics and a single middle sacral, but as calcification is not commonly observed in these, they will not be discussed further.

Calcification has been observed most frequently in the branches of the coeliac axis. The shadows cast are diverse in character and are best shown by illustrative cases. In the following case presentations the plan has been to proceed from the most easily recognized examples to the more difficult, rather than to follow a chronological order. For convenience, the cases have been divided as follows: (1) Cases showing multiple ring or tubular shadows; (2) cases showing multiple crescentic or curvilinear shadows; (3) cases showing single ring, tubular, crescentic, or curvilinear shadows.

CASES SHOWING MULTIPLE RING OR TUBULAR TYPE OF CALCIFICATION

Case 1: Branching Tubular Shadows over Left Upper Quadrant Shown at Autopsy to be Due to Arteriosclerotic Calcification of Splenic Artery.—I. H., a diabetic, of sixty-five years, gave a history of hypertension of many years' standing. She showed

signs of cardiac failure and did not improve under digitalis therapy. Her illness terminated fatally in the hospital.

Roentgen examination of the chest showed an enlarged heart with hypertrophy and probable infarct of the left ventricle, arteriosclerotic changes of the aorta, and chronic passive congestion of the lungs. An abdominal film (Fig. 1), taken to determine if urinary stones were present, showed an interconnecting set of branching calcified vessels at the level of

autopsy to be due to aneurysmal dilatation. These shadows represent calcification in a case of uncomplicated arteriosclerosis of the vessel walls.

At autopsy[3] the heart was found to be much enlarged, weighing 600 gm., with thickened coronary walls (calcareous in proximal portions) and moderate thickening at the margins of the aortic and mitral valves. There was much roughening of the intima of the arteries of the abdominal region, and numerous yellow plaques were

Fig. 1. Case 1: Extensive calcification of branches of splenic artery proved at autopsy to be due to arteriosclerosis.
Abdominal film of diabetic woman of sixty-five years, showing branching tubular structures relating to the splenic artery. Note the fainter shadows at arrow, representing arteriosclerosis of less marked degree also occurring in branches of coeliac axis. The shadow on the right represents massed fused gallstones, confirmed at autopsy, rather than calcification in the walls of the gallbladder.

the dorsolumbar junction. The tubular character of the shadows indicated their vascular origin. Near the point of the arrow in the illustration are less dense shadows of a similar character, lying opposite L-1.

Visualization of the calcification of these arterial branches of the coeliac axis was facilitated by (1) the large amount of gas in the stomach, (2) the unusually dense character of the calcification, which took the form of continuous sheets, (3) relative absence of intestinal contents over the area. None of the shadows was found at

present. In some regions, as in the left upper quadrant near the spleen, the walls of the splenic artery were heavily calcified. The gall-bladder walls were not calcified but the organ was tightly contracted and contained a compact mass (4–5 cm.) formed by several facetted stones. Several isolated stones were seen at the neck of the gallbladder.

Case 2: Numerous Ring and Tubular Shadows Scattered over a Wide Area of the
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[3] The autopsy data were obtained through the courtesy of Dr. G. H. Whipple.

Fig. 2. Case 2: Multiple ring and tubular shadows widely scattered over left upper quadrant.
The patient was a woman of sixty-eight years who was under treatment for hypertension and diabetes. Over 15 shadows due to calcified arteries were observed in this case. Note their tendency toward grouping and the wide diameter of several shadows suggesting aneurysmal dilatation.

Fig. 3. Case 3: Multiple ring-like shadows simulating left-sided gallstones overlying the upper pole of the left kidney, shown at operation not to be related to kidney structure.
Note that the shadows have no connection with the pyelographic structure. While they resemble gallstones at first glance, closer observation will show that the rings are incomplete and that there is no tendency to form facets.

Left Upper Quadrant, the Diameters of Several Suggesting Aneurysm.—C. R., a woman of sixty-eight years, entered the hospital with diabetes. She showed a mild hypertension and a generalized arteriosclerosis.

An abdominal film (Fig. 2) showed numerous ring-shaped, crescentic, and single tubular shadows in the left upper quadrant. These were located in part at the dorsolumbar junction but many extended upward as high as D-11. The diameters of several suggested possible aneurysmal dilatation. Various opinions were expressed by different observers as to the significance of the shadows when the films were first viewed. Pancreatic calculi, calcification in the walls of diverticula of the colon, concretions within the bowel, and gastric calcification in polypoid tumors were all suggested. The fundamental character of the lesion is not difficult to identify, however, if one recalls the location and ring or arcuate form of the shadows, and the age and condition (diabetic) of the patient.

In this case there were present, also, an aneurysm with calcified walls involving the right renal artery and calcification in the walls of the superior gluteal and other branches of the hypogastric arteries. The patient is still living and is being followed for her diabetic condition.

Case 3: Ring and Crescentic Shadows, Simulating Left-sided Gallstones, Located Near the Lateral Margin of the Upper Pole of the Left Kidney.—C. C., a sixty-four-year-old woman, entered the hospital for treatment of a large calculus of the left kidney.

A single abdominal film (Fig. 3) showed a large staghorn calculus ramifying out into the upper and many of the lower calices of the kidney. Near the upper pole was a grouping of ring-like shadows compactly arranged, which at first glance might be taken for multiple calculi. In view of

Fig. 4. Case 4: Multiple arcuate shadows grouped over left upper quadrant. Their position is lateral to the upper pole of the kidney near the medial border of the spleen and they are partly overlapped by the gastric bubble. A pyelographic examination proved their extrarenal character.

Fig. 5. Case 5: Two ring-like shadows lying opposite the 11th and 12th dorsal vertebræ, interconnected by long curvilinear shadow of increased density. This case is of interest because it shows calcification of one of the proximal branches of the coeliac axis as well as a more distal one. The patient is still living, with severe diabetes.

our previous experience, however, a diagnosis of calcification of the arterial walls of the branches of the splenic artery was made. A pyelogram showed hydronephrosis on this side but demonstrated no connection with the ring-like calcifications about the upper pole. It was apparent that these shadows bore no relation to any portion of the kidney. It will be noted that the calcification lay at the level of the dorsolumbar junction near the medial border of the spleen approximately 2 cm. from the spine. The shadows consist of large crescents, nearly complete rings, and several short arcuate lines.

This case was checked further by nephrectomy. The kidney showed evidence of hydronephrosis and a massive calculus, but there was no calcified mass attached to the upper pole, thus demonstrating that the shadows described above were entirely extrarenal.

Case 4: Grouped Arcuate and Ring Shadows about Lateral Aspect of Upper Pole of Left Kidney.—M. L., a female of sixty years, entered the hospital with a duodenal ulcer, which had been previously treated by pyloroplasty. During her stay in the hospital she was found to have a moderate hydronephrosis.

Roentgen examination consisted of a single anteroposterior film and stereoscopic pyelographic films (Fig. 4). The abdominal film showed a compact grouping of arcuate and ring shadows at the level of D-12, approximately 6 cm. from the lateral margin of the spine. They lay lateral to the kidney and were not in the usual position representing calcification within the adrenal. Their character was recognized at the time of the first examination as arteriosclerosis with calcification of branches of the splenic artery. Pyelographic films demonstrated their extrarenal character. The patient also showed evidence of calcification within the hypogastric arteries of the pelvis and a calcified fibroid. No calcification was identified within the abdominal aorta.

Case 5: Complete Ring Shadow Located along the Left Lateral Margin of the Lower Dorsal Spine with a Laterally Placed Crescent, the Two Connected by a Curvilinear Set of Calcified Plaques.—W. C., a male of seventy-three years, entered the hospital for a perineal prostatectomy. He was known to have diabetes and had been previously treated for an infection of the left foot secondary to arteriosclerotic changes.

Roentgen examination consisted of an abdominal film (Fig. 5) showing a ring-shaped shadow immediately to the left of the lower margin of D-11, while farther to the left of D-12 was a crescentic shadow of increased density suggesting a plaque in
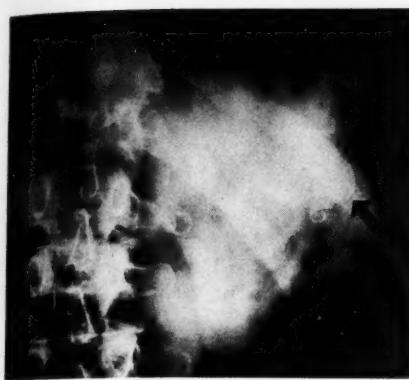
Fig. 6. Case 6: Ring and tubular shadows indicative of calcification in both the proximal divisions of the coeliac axis, and the more distal portions of the splenic artery. The vessel near the arrow assumed a serpentine course and was calcified for 6–7 cm. of its length, while the finer dimensions within the spleen show no evidence of calcification.


Fig. 7. Case 7: Scattered arcuate and mottled densities to the left of the dorso-lumbar junction due to patchy calcification of the coeliac axis and possibly the superior mesenteric. This film was interpreted by some as representing a probable calcified tumor of either the kidney or adrenal, while others considered a calcified hematoma more likely. A pyelographic study demonstrated the absence of any space-occupying mass within the kidney or adjacent to it. The arcuate character of the shadows should give the clue to their nature.

a vessel seen on end. Between these two main arterial shadows was observed the sweeping curved outline of arterial plaques in vessels connecting these two branches. Their level suggested that calcification was present within branches of the coeliac axis. The more peripheral branches of the splenic artery were not visualized at this examination. This patient, however, showed other evidence of arteriosclerosis, including calcification of the abdominal aorta, at the level of L-3 and L-4, and calcification of the superior gluteal and hypogastric arteries.

Since his discharge from the hospital the patient has continued to have some difficulty with the foot infection and is now being followed in the vascular clinic.

Case 6: Ring and Tubular Shadows along the Left Margin of L-1 with Laterally Placed Serpentine and Circular Shadows along the Region of the Medial Border of the Spleen.—G. J., a male of seventy-one years, entered the hospital because of difficulty in voiding and incontinence. Physical examination showed evidence of a benign prostate hypertrophy and hypertensive heart disease.

An abdominal film (Fig. 6) showed a complete ring shadow, measuring nearly a centimeter in diameter, at the tip of the left transverse process of L-1. Sweeping upward from this shadow was a tubular shadow which reached the level of D-12 at its inferior margin. These would appear to represent the first branches of the coeliac axis. The splenic branch in addition showed a profound calcification in its walls, forming a serpentine shadow lying along the medial border of the spleen, while near by was a complete ring shadow apparently representing a pancreatic branch seen on end. The finer divisions of the splenic artery after penetrating the organ showed no roentgen evidence of calcification within the vessel walls. In the pelvic region there was a profound degree of calcification in the internal iliacs, both of these vessels being calcified throughout their extent, while the hypogastrics and their branches showed relatively little calcification within their walls.

CASES SHOWING MULTIPLE CRESCENTIC OR ARCUATE TYPE OF CALCIFICATION

Case 7: Multiple Crescentic and Curvilinear Shadows; Calcification of Walls of Coeliac Axis and Probably of Superior Mesenteric Arteries; Observations a Year and a Half Later.—G. P., a male patient of

Fig. 9.   Case 9: Single ring-like shadow of left upper quadrant, probably due to small aneurysm of splenic artery.

The patient (aged fifty years) is a diabetic who is still alive.   The isolated shadow is the only one noted on the entire film related to calcification. Its diameter would appear to rule out simple arteriosclerotic calcification since there is no vessel of this size in this location.

Fig. 8.   Case 8: Scattered arcuate lines at level of dorsolumbar junction. Note the position of these shadows in the lateral projection and the marked calcification of the lower abdominal aorta.

sixty-five years, had a urethral stricture. An abdominal film (Fig. 7) showed calcification about the upper pole of the left kidney, which was variously interpreted as calcified tumor of the kidney or adrenal gland, calcified hematoma, and calcification in a cold abscess.

It should be noticed that the shadows are in part arcuate and that many of the mottled densities are arranged in the form of a section of a circle.   Since stereoscopic films showed the shadows to lie well anterior to both the kidney and the adrenal and the distribution of the calcium deposit definitely suggested calcification in the walls of the main branches of the aorta, it was believed probable that the origins (or first portions) of both the coeliac axis and superior mesenteric were visualized.

This patient was spared a pyelographic study. He was kept under observation for the urethral stricture and a chronic cystitis, and one and a half years later a third set of abdominal films was made. The general orientation of the calcified plaques remained unchanged.

*Case 8: Few Arcuate Lines at Level of D-11 and D-12 with Calcification of the Abdominal Aorta from Level of L-2 to L-4.—*J. B., a seventy-six-year-old female, entered the hospital because of arthritic symptoms.

Films of the dorsolumbar spine (Fig. 8) showed, in addition to moderate degenerative changes, an arcuate shadow at the dorsolumbar junction, 4 cm. from the lateral margin of the spine, and grouped near this, irregular indistinctly outlined mottled shadows of similar density. In

the lateral projection these shadows lay approximately 3 cm. in front of the spine. The abdominal aorta was calcified from L-2 to L-4, inclusive.   A chest film showed arteriosclerosis of the aortic arch.

This patient is still alive, although on a second admission to the hospital she showed a right hemiplegia, clinically believed to be secondary to a cerebral thrombosis.

CASES SHOWING SINGLE ARCUATE OR RING TYPE OF CALCIFICATION

Case 9:   Single Ring-like Shadow Probably Due to Small Aneurysm of Splenic Artery.—L. N., a woman only fifty years of age, had been previously treated for nephrolithiasis and diabetes mellitus.

An abdominal film (Fig. 9) following nephrolithotomy showed no calculi over the renal area, but several centimeters above the upper pole of the left kidney, and slightly lateral to it, was a rounded shadow 1.5 cm. in diameter with a non-opaque center and a faintly outlined periphery. The location and character of this shadow were believed to be consistent with a small aneurysm of one of the branches of the splenic artery.

The patient is still being followed for the diabetic condition.

Case 10:   Single Crescent to the Left of the Dorsolumbar Junction.—J. W. was a sixty-three-year-old white female, with a previous diagnosis of tabes with evidence of Charcot joints at the knees, ankles, and lumbar spine.

The spine (Fig. 10) showed in addition to the Charcot lesions a single arterial crescent lying to the left of the dorsolumbar junction, immediately beneath the 12th rib. No other vascular calcifications were observed. This slightly arcuate line represents an arterial plaque in one of the first branches of the coeliac axis without any evidence of calcification of the more peripheral branches.

Case 11:   Single Arcuate Shadow at Level of D-12, Probably Representing the Coeliac Axis at Its Origin. Extensive Calcification of Thoracic and Abdominal
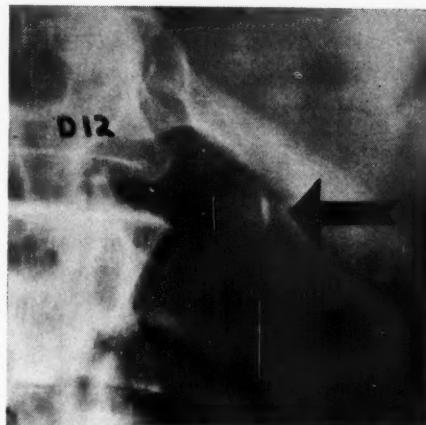
Fig. 10. Case 10: Single crescent several centimeters to the left of dorsolumbar junction, related to calcification of the proximal portion of the coeliac axis.

Aorta.—L. V., a seventy-year-old housewife, had a past history of arteriosclerosis, hypertension, arteriosclerotic and hypertensive heart disease, Parkinsonian syndrome, and a probable coronary occlusion.

An abdominal film (Fig. 11) showed a broad irregular crescent lying to the immediate left of D-12. This shadow was in line with the course of the descending aorta, which was readily visualized as it passed through the aortic foramen of the diaphragm. The original interpreter of this film recognized this shadow as some form of calcification but was at a loss to explain its character.   Two and a half years following the first abdominal film another examination was made because of back pain, and an identical shadow appeared in the same location, essentially unmodified in orientation and general character. This film was interpreted by a second roentgenologist, who suggested that it might represent an unusual phlebolith. Its character becomes clear if its orientation on the stereo films is studied. This shows the shadow to be related definitely to the upper abdominal aorta and the arcuate line to calcification at the origin of the main coeliac axis.

The patient is still being followed for her cardiac condition.

Case 12: Single Tubular Calcification at Level of Dorsolumbar Junction in an Elderly Subject Without Abdominal Complaints.—H. S., a sixty-eight-year-old male, complained chiefly of back pain. An abdominal film (Fig. 12) showed a tortuous vessel lying at the level of the dorsolumbar junction, its long axis being directed laterally. Its position would suggest calcification in the walls of the splenic artery without aneurysmal formation. On the right side of the abdomen calcification was observed within the walls of the renal

the abdominal film. Since one third of the patients had diabetes, the discovery of arterial calcification in abdominal films should suggest the desirability of laboratory tests of the urine, if these have not already been made. As might be expected, these patients frequently showed calcification of arteries elsewhere (examination of fundus of eye, palpation of wrist, and radiography of the chest).

The recognition of the shadows described as evidence of advanced arteriosclerosis of the coeliac axis, a diagnosis
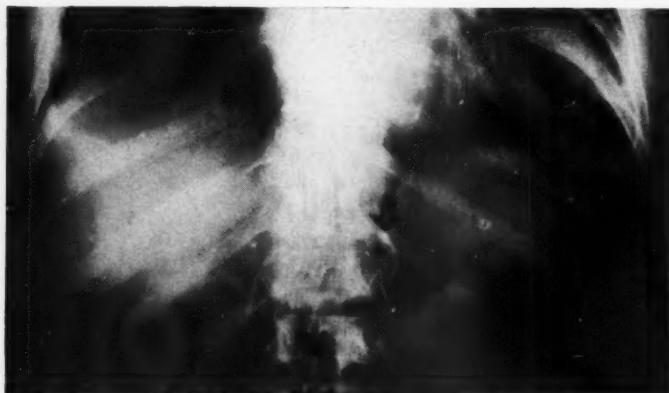
Fig. 11. Case 11: Single arcuate shadow at level of 12th dorsal vertebra probably representing the coeliac axis at its origin. Note the extensive calcification of the aorta as it passes through the hiatus of the diaphragm overlapping the crescentic shadow.

artery and in one of the other branches of the aorta. The common iliac also showed considerable calcification.

The patient later died, but no autopsy was obtained.

DISCUSSION

The above cases are illustrative of the diverse character and the typical distribution of the shadows produced by calcification of branches of the coeliac axis. They have been seen more frequently in elderly women than men. With one exception, all the patients were sixty years of age or over. This exception was a diabetic female of fifty years with a small single aneurysm of the splenic artery without evidence of arteriosclerosis elsewhere on

frequently missed, is not difficult if the common variations in the shape of these calcifications and the usual location of the shadows on the abdominal film are kept in mind.

The location of the shadows at the level of the dorsolumbar junction is typical of calcification in the arterial walls of the coeliac axis. If the calcification involves the proximal portion of the artery the shadows lie opposite D-12 or L-1, along the left lateral margin of the spine, but if the distal branches are involved the position over the left upper quadrant will vary widely, depending on the level of the diaphragm and therefore upon the position and habitus of the patient and the phase of respiration. The fact that the left gas-

tric artery and the main splenic branch of the splenic artery serve organs which vary greatly in position, depending particularly on diaphragmatic excursion, while the numerous pancreatic branches of the splenic serve an organ which is not affected by diaphragmatic movement, might be expected to possess differential value. Although the writer has had no experience as to this point, it is possible that films obtained at maximal expiration and inspiration might aid materially in identifying the particular branch affected.

The number of shadows has varied from a single small plaque to a score or more. Multiple shadows frequently show a tenddency toward grouping. This was so striking in several of the cases in which nearly complete ring shadows were formed, as to simulate massed gallstones within the gallbladder, and the shadows might have been so interpreted but for their position on the left side of the body.

While the shapes of the shadows varied greatly, they possessed one common characteristic—the typical appearance was that of a small or large segment of a circle. In some cases the circles appeared essentially complete (although the density was decreased over certain portions) while in other cases only short arcuate lines were to be seen. Straight plaques were infrequent, occurring in a few cases in which arcuate or ring shadows were also present. Tubular shadows, representing the course of the splenic artery, were uncommon, and the infrequency with which the course of the vessels may be followed for any considerable distance on the abdominal film indicates why so many of the shadows are not identified by those unfamiliar with these arterial calcifications. In one of our cases, however, not only was the tubular character of the shadows apparent, but their branching from a common stem as well.

Only the larger vessels have shown much calcification. The smaller branches within the spleen, pancreas, or wall of the stomach have not been identified. While it is possible without detailed study to

recognize the main branch of the aorta affected by calcification (due to the location over the left upper quadrant at the level of L-1 or above, in case of calcification of the coeliac axis), it may be quite difficult to determine the specific branch of the coeliac axis involved. Barium studies have not aided materially. Location of the shadows over the gastric contour in the anteroposterior film constitutes no evidence that the branch involved is the left gastric rather than the splenic. In the first case of this series the branching

Fig. 12.   Case 12: Single tubular shadow at level of 12th dorsal vertebra. Its long axis is directed laterally to the spleen. No evidence of aneurysmal dilatation. (Retouched photograph.)

vessels overlay the gastric bubble, but at autopsy the calcification was proved to be within the walls of the splenic artery. With calcification of the left gastric the shadow would be expected to lie over the medial portion of the left upper quadrant, since the artery serves the lesser curvature of the stomach and the region about the lower esophagus and cardia. Calcification of the splenic artery is usually seen over the mid portion of the left upper quadrant. The periphery of the left upper quadrant is usually devoid of shadows attributable to calcification within arterial walls (phleboliths are not uncommon). Calcification in the pancreatic divisions has not commonly been observed. Figure

6 shows a circular shadow immediately below the splenic artery that is probably cast by one of the pancreatic divisions. The pancreas is located at the level of the first lumbar, and the short branches serving the body and tail of the gland (six or more in number) approach it from above. Because of their short length and the fixed character of the pancreas, the position of pancreatic divisions would be expected to shift very little on respiration. The grouped ring shadows shown in Figures 3 and 4 probably represent the terminal divisions of the splenic artery near the hilum of the spleen.

Calcification over the right upper quadrant due to arteriosclerosis of the hepatic branch of the coeliac artery has rarely been observed in this series. The relative absence of crescentic or ring shadows due to arterial calcification over this quadrant, above the level of the kidney, is a striking observation, and a fortunate one, since the presence of ring shadows on this side would offer confusion in diagnosis of cholelithiasis and might on occasion result in fruitless surgery. The writer is not familiar with any instance in which such confusion has arisen,[4] although the remote possibility should be carried in mind since avoidance of this error is easy by the use of a lateral abdominal film or cholecystography.

The lateral projection has proved of aid in this series. The majority of these calcifications in the left upper quadrant are seen in the lateral projection to lie in front of the vertebral column, the distance varying from a few millimeters to several centimeters. This serves to differentiate arteriosclerotic calcification from calcification within kidney tumors which overlie the spine posteriorly and from gallstones, which show an anterior position.

The identification of aneurysms rests upon two findings: (1) a rounded shadow whose diameter exceeds that of any normal vessel of the region; (2) the shape of the

shadow, which in most instances is an incomplete ring, the break in the ring representing the mouth of the aneurysm. Not all aneurysms, however, will present these signs. The diameter of an aneurysm involving a small arterial branch, for instance, in a region in which larger arteries are present, might not be larger than those of the latter vessels. Also, the ring will appear complete in those cases in which the aneurysm is projected axially (fundus and mouth of aneurysm in line).

Clinical Importance.—The recognition of shadows due to arterial calcification is important, although there is little that can be done therapeutically for abdominal arteriosclerosis. In the first place, the identification of the shadows on the abdominal film as produced by arterial calcification spares the patient further diagnostic procedures. In our series of cases pyelography, gastro-intestinal examinations, and radiography of the spine have been resorted to in an effort to establish a diagnosis. In one instance, in which the calcification was directly superimposed over the kidney in the anteroposterior projection the patient was advised of the possibility of a kidney tumor, but refused retrograde pyelography and insisted on returning home.

In the second place, there is a real need for identifying bleeding aneurysms. Machemer and Fuge have described the symptoms and the importance of recognizing such aneurysms of the splenic artery. They may be treated surgically by ligation even after initial rupture, since it is a secondary rupture at some later date that produces the fatal termination. The presence of mild or colicky pain over the upper epigastrium, the finding of a systolic murmur or bruit over the left upper quadrant, and the roentgen discovery of a ring of calcification in typical position, will point to the diagnosis if the possibility is carried in mind in the presence of conditions simulating pancreatitis, ectopic pregnancy, and ruptured ulcer.

Unless one has had experience with the diversity of the shadows produced by

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[4] A case of right-sided calcification has been observed since the completion of this paper, in which exactly this situation has arisen.

arterial calcification of the abdominal vessels, the diagnoses offered will be many and varied. In this series, pancreatic calculi, calcification in walls of colonic diverticula, gastric calcification, concretions within the bowel, kidney tumor, adrenal tuberculosis or tumor, calcified hematoma, and phleboliths were suggested as possibilities. In most of these cases the writer was the first to see the films for interpretation, but in several instances in which the above diagnoses were offered by others on routine study, a subsequent review of the films failed to convince them that these shadows were cast by arterial calcification. This was apparently due to the fact that many radiologists are not accustomed to make this diagnosis, and many have expressed doubt that such marked calcification could be due to such a simple cause. As radiography improves with the use of tubes with rotating targets, it is certain that these shadows will be frequently encountered in elderly subjects.

The writer freely admits that many of these cases are unverified. In the 3 cases, however, which either came to autopsy or were surgically explored, the final evidence was corroborative. The remaining patients have been followed for periods varying from five months to ten years and review of their histories revealed no clinical data that would contraindicate the diagnosis.

CONCLUSIONS

1. Calcification of the arterial walls of the coeliac axis is frequently observed in elderly subjects.

2. The location of the shadows is typically over the left upper quadrant, the proximal branches lying at the level of the dorsolumbar junction while the more distal branches vary widely, shifting in position with the organ supplied.

3. The calcification produces shadows of diverse shapes, varying from short crescents to complete rings. Straight plaques alone are rarely observed.

4. While the branches of the coeliac artery serve the organs of both upper quadrants, calcification over the right upper quadrant (hepatic branch) is rarely identified.

5. Over the left upper quadrant the calcification is commonly multiple, a score or more lesions being observed in one of our series.

6. Calcified aneurysm may be identified under favorable circumstances.

7. Identification of these shadows is important, since diagnostic confusion may lead to needless instrumental procedures in some instances and in rare cases of ruptured aneurysm a missed diagnosis may postpone a needed operation.

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INTRA-ABDOMINAL CALCIFICATION: THE INTERPRETATION OF ITS ROENTGENOLOGIC MANIFESTATIONS[1]

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IN THE routine interpretation of roentgenograms of the abdominal field, the radiologist is frequently confronted with deposits of calcium in various tissues. The presence of these deposits is often mentioned merely as an incidental finding, which indeed it may be. However, the detection and proper evaluation of these deposits may provide the clue to the diagnosis. Instead of the mere mention of its presence, the radiologist's considered opinion of the significance of the deposit may be of the utmost importance to the referring physician. In general, little difficulty in interpretation is encountered if these concretions appear in characteristic shape and position. On the other hand, when calcium appears in unusual positions and assumes a configuration which is not particularly characteristic, the interpretation may tax the ingenuity of the trained radiologist. In many instances, however, a study of the nature and disposition of the calcium deposit will reward the radiologist in that this study will have provided useful information to the physician which would not have been disclosed by a more casual observation.

It has been shown that pathologic calcification may occur in any mesenchymatous tissue of low metabolism or decreased blood supply, or following the fibrosis of trauma or infection. Similarly the calcification of tumors is observed when the blood supply is so impaired that degenerative changes have appeared, as is seen in uterine fibroids and in the fibrous walls of cysts and blood vessels. However, as it is not intended that a review of the mechanism of pathologic calcification be undertaken at this time, the reader is referred to several excellent articles on the subject (3, 7, 11).

In attempting to interpret the significance of apparent deposits of calcium, one must be aware of certain simulants and artefacts which are sometimes found and which may be confusing. Such things as warts, hair, nevi or opaque medication on the skin, dirty or damaged intensifying screens, opaque pills, metallic foreign bodies or residual barium in diverticula of the bowel, may lead to erroneous conclusions.

In analyzing a roentgenogram of the abdominal field it is often convenient to study the four quadrants separately and then to coördinate the various findings. Therefore, in interpreting the significance of deposits of calcium, this discussion will follow, in part, a similar scheme.

In the right upper quadrant deposits of calcium in various forms are most commonly found in the renal and biliary tracts, pancreatic, adrenal, subdiaphragmatic, and paravertebral areas. Modern cholecystography and urography have almost entirely eliminated haphazard interpretation of biliary and renal lesions. Confusing shadows on the roentgenogram, however, are frequently encountered. A ring-like or C-shaped shadow of calcification with a clear or slightly mottled center is sometimes found in the region of the notch of the liver (Fig. 1). This represents a single large stone 1 to 1.5 cm. in diameter in the cystic duct near the junction with the common bile duct. The gall bladder itself may be visualized owing to the presence of milk of calcium bile, calcium débris, or multiple stones in the fundus, giving the erroneous impression of a functioning gall bladder. Calcification in the walls of a non-functioning gall bladder generally shows the complete outline of the organ, appearing more dense at the periphery than through the main body and often containing small denser concretions rep-

Fig. 1. C-shaped shadow of calcification in the region of the notch of the liver represents a stone impacted in the cystic duct. The gall bladder is outlined by milk of calcium bile. The kidney is outlined by opaque media. Rotation of the patient has brought the various structures into better relief.

Fig. 2. Extensive pancreatic lithiasis as seen in the lateral view. A cyst of the pancreas is outlined by a fine deposit of calcium in its walls. The calculi in the body and tail of the pancreas extend posteriorly and superiorly toward the body of the first lumbar vertebra.

resenting stones or amorphous calcium collections at the fundus.

Such lesions may be confused with a large rounded stone in the pelvis of the right kidney, which, although simulating the shape of a gall bladder, will show a more uniform distribution of calcium throughout. Rotation of the patient, a lateral view, or a urogram will clarify the picture if one is unable to make a definite diagnosis from the plain roentgenogram. Occasionally one finds calcification in the walls of a pancreatic cyst which may appear identical with a calcified gall bladder. These cysts, however, are situated posterior to the region of the gall bladder and are generally found much further to the left than the usual position of the gall bladder. The calcium deposit is fine and homogeneous, outlining the walls of the organ in a hair-like line. Such lesions are best seen in the lateral roentgenogram (Fig. 2). Echinococcus cysts in the liver or kidney also may simulate calcification in the walls of the gall bladder. These spherical cysts are large and are commonly multiple. The margins of the cysts are usually clearly demarcated with a fine line of calcium, and one is often able to see calcification in the walls of the daughter cysts within, or attached to the main cyst, an appearance characteristic of the lesion. Moreover, the calcification in the walls of these cysts is of a rather mottled type, unlike the peripheral concentration of calcium seen in a calcified gall-bladder wall, or the homogeneous calcification of a renal stone, appearing in a blotchy, smeared, irregular pattern (Fig. 3).

Pancreatic lithiasis may cause some con-
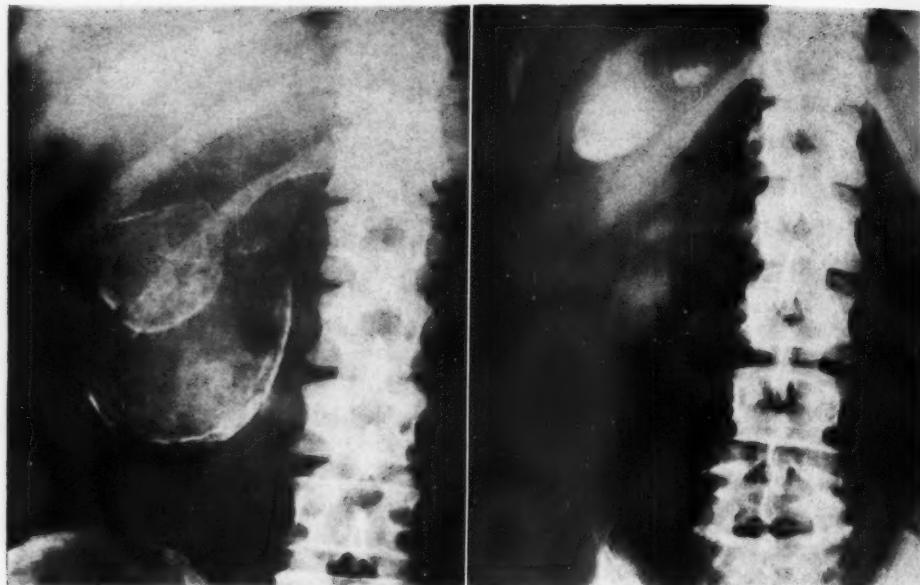
Fig. 3. Echinococcus cysts of the kidney, show-
ing the mottled, blotchy or smeared, irregular
deposition of calcium which is characteristic of
these spherical cysts. Echinococcus cysts are
commonly multiple.

Fig. 4. Ragged and extensive deposit of calcium
in an abscess cavity in the substance of the liver.
The intrahepatic position is maintained in the
lateral views. The gall bladder is outlined by
opaque media.

fusion in the interpretation of roentgeno-
grams of this region, especially when the
stones are confined to the head of the
organ. This type of calcification is almost
invariably found over the body or right
transverse process of the first lumbar
vertebra, or between the first and second
lumbar vertebræ, when viewed in the
anteroposterior projection. It appears as a
group of discrete concretions of irregular
shape, varying from small punctate collec-
tions to more massive stones about 1 cm.
in diameter scattered over an area 5 cm.
or more in width. In most instances the
stones are confined to the head of the
organ, but they may be found throughout
its entire length, in which case they extend
across the mid-line toward the left upper
quadrant in an open or loose S-shaped
curve 15 cm. or more in length. In the
lateral view of the abdomen, the stones in
the head of the organ lie in the mid-ab-
dominal region, while those in the body and
tail extend posteriorly and superiorly

toward the body of the first lumbar ver-
tebra.

Not to be confused with pancreatic
stones are the calcifications of the inter-
vertebral disks in the upper lumbar region.
This type of calcification is, of course,
confined to the region of the intervertebral
disk in both anteroposterior and lateral
views. In addition, hypertrophic arthritic
changes in the vertebræ in this region may
complicate interpretation, especially when
the osteophytic lipping is extensive and
appears to be detached from the verte-
bræ. If the hypertrophic changes are
extensive, they will be found to involve
many vertebræ or the involved vertebra
in question will show evidence of old in-
jury. Comparison of the anteroposterior
and lateral roentgenograms should readily
reveal the true nature of such lesions.
Deposits of calcium in the adrenal glands
may be confused with pancreatic lithiasis,
as the appearance of the two is somewhat
similar (2, 4). Generally, however, cal-

cification in the adrenals is of a finer, ir-
regular, punctate nature, conforming to
the size and shape of the adrenal glands
in its distribution; more rarely it appears
as a gross calcification of the entire gland.
It is found about one vertebral segment
higher than pancreatic calcification, usually
at the junction of the upper outer border
of the psoas shadow with the upper pole
of the kidney. Rarely, calcification in the
wall of an adrenal cyst may be observed.

Occasionally one encounters calcification
in a lymph node of the biliary tract in the
region of the notch of the liver. This node
is usually of a large size and closely re-
sembles the large, rounded, single stones
found in the pelvis of the kidney, with the
exception that it appears to be more of a
mottled type of deposit. It is found in a
higher position in the abdomen than the
usual situation of the kidney pelvis or the
gall bladder. It presents a different type
of calcification from that found in the more
common variety of mesenteric node situ-
ated in the right lower quadrant, in that
the calcium deposit is more concentrated
in the periphery of the lesion and does not
appear to be a conglomeration of small
individual concretions. Another example
of this uncommon form of lymph node
calcification has been observed well to the
left of the mid-line at about the level of
the umbilicus.

Calcification in an abscess of the liver
(Fig. 4) is similar to the type of calcifica-
tion found in abscesses in other situations:
that is, it conforms to no definite pattern
or shape but is irregular and ragged in out-
line with a blotchy distribution of the
calcium deposit. These cavities may be
single or multiple and are generally found
higher in the right upper quadrant than
other types of calcium deposit except those
associated with a subphrenic abscess.
They should not be confused with a
Ghon tubercle lying in the posterior pul-
monary sulcus. Anteroposterior and
lateral projections will reveal the true posi-
tion of the abscess cavity within the sub-
stance of the liver. Rarely, calcification in
metastatic foci, gummas, and hemangio-

mas may be found. The deposition of
calcium in a subphrenic abscess is entirely
different. This takes the form of long,
ragged, parallel streaks lying between the
diaphragm and the liver, sometimes slightly
curved to conform to the shape of the
cavity in which it is deposited. Confusion
of this type of calcification with that found
in a hematoma of the lower part of the
chest wall or calcification in the pleura will
be avoided if it is noted that the latter
extends above the leaf of the diaphragm
and tends to be distributed in a thin
plaque-like formation. Calcification in the
costal cartilages also may be confusing.
However, this type of calcium deposit is
multiple and bilateral, taking a mottled
linear configuration in an inferolateral
direction from the sternum to the bony
ends of the ribs.

Certain of the lesions described in the
preceding paragraphs are not confined to
the right alone, but may be found in the
left upper quadrant. Apart from these,
the most common site of calcium deposit in
the left upper quadrant is the spleen.
Calcification of the splenic artery may
cause some difficulty in interpretation of
lesions in the left upper quadrant. The
vessel may be seen end on and appear as a
ring of calcium with a clear center. When
the deposit is extensive, the complete out-
line of the vessel may be followed from its
origin in the region of the left transverse
process of the first lumbar vertebra through
a tortuous course upward toward the
eleventh rib (Fig. 5).

There has been considerable discussion
in the literature concerning the nature of
certain calcium deposits in the spleen. It
has been stated that phleboliths are not
found in the spleen, and that the multiple
discrete areas of calcification represent
tuberculomas. It appears that this state-
ment is not altogether correct, since in-
vestigation has demonstrated that both
phleboliths and tuberculomas may occur in
the spleen. Similar lesions may be found in
the liver. Phleboliths have been described
as homogeneous, smooth, rounded or ovoid
concretions varying in size from about 1

mm. to 1 cm., generally widely dispersed throughout the organ. In contradistinction to these, the deposits of calcium in tuberculomas are more ragged in outline, larger, and less numerous, although they too may be widely dispersed throughout the parenchyma of the spleen. The differentiation of the type of calcification occurring around *Pentastoma* larvae may be extremely difficult or impossible to accomplish. The close resemblance of this type of calcification to that of phleboliths or tuberculomas will often preclude the possibility of a definite diagnosis. *Pentastoma* calcifications have been described as showing a clover-leaf type of distribution and as being few. This may be of some aid in their differentiation.

Formations of calcium, similar in many respects to those found in subdiaphragmatic abscess, may be laid down about the spleen following various infectious processes and other diseases, as, for example, typhoid fever or leukemia, or following trauma to the spleen (10). Calcium may be laid down in infarcts also, although this is not a common roentgenographic finding. These deposits are of a diffuse, porous type with fairly sharp demarcation of the borders, and they extend toward the periphery of the spleen in triangular or ovoid configuration, depending on the projection in which the roentgenogram is made. The base of the deposit lies toward the periphery of the organ and the apex toward the hilum (1). Cystic lesions containing calcium in their walls are occasionally found, but the causation of such lesions is often obscure.

A detailed description of the various types of calcification and ossification of the kidney will not be entered into here, as this subject is extensive in itself. Only those lesions which are rather common findings and which require differential diagnosis from other types of calcification found in the abdominal roentgenogram will be considered. The reader is referred to the excellent and comprehensive studies on this subject to be found in the literature (5).

In the right lower quadrant the most common type of calcium deposit, apart from renal lesions, is that in mesenteric nodes. These nodes present a very characteristic picture, appearing as single or multiple collections of irregular small flecks of calcium not unlike a raspberry in size and configuration. They are found most commonly just lateral to the transverse process of the fourth or fifth lumbar vertebra. Nodes similar to these may be observed extending across the mid-line, and superiorly in a chain-like manner in the paravertebral region. Uncommonly they may be found in the left mid-flank region, although the single large node which has been described previously is a more usual finding in this area. Another type of paravertebral calcification is that which occurs following suppurative processes of the lumbar or lower thoracic vertebræ, as in tuberculous or typhoid spondylitis (10). These calcium deposits have an irregular mottled distribution which follows the contour of the psoas muscles. A lateral view of the spinal column will reveal the site of the disease process. In certain instances, atheromatous plaques or calcification in an aneurysm of the abdominal aorta will simulate calcification in a psoas abscess. In the left paravertebral region, a small plaque of calcium in the abdominal aorta may easily be confused with a stone in the left ureter. Calcification in the iliolumbar ligaments should cause no difficulty in diagnosis.

The appendix appears to be a favorite site for the collection of foreign bodies of various kinds. It is not uncommon to find one or more lead shot trapped here, particularly in the pheasant- and duck-shooting seasons. Metallic bodies of this sort have a different appearance than has barium which has been caught in the appendix or in a diverticulum. They present a more homogeneous density and more distinct margins than the shadows cast by barium. Deposits of calcium may be laid down around such foreign bodies (8). A rather rare form of intra-abdominal calcification is that which occurs in epiploic appendages. These disk-like concretions

Fig. 5.   The outline of the splenic artery may be seen from its origin in the region of the left transverse process of the first lumbar vertebra through a tortuous course upward toward the eleventh rib.   More commonly the vessel is outlined as a ring of calcification in the same region and must be distinguished from a large renal stone.

Fig. 6.   Extensive calcification in multiple large leiomyomas of the uterus.   This type of deposit is quite characteristic, having the appearance of the imprint of a sponge which has been dipped in white-wash.   The margins of calcified fibroids are slightly roughened but generally regularly rounded.

more or less retain their original shape but lose their connection with the colon and, as loose bodies, gravitate into the pelvis, where they may cause considerable difficulty in diagnosis.   Several views in different positions will show that they are apparently unattached, as they change their relation with one another and with fixed landmarks.

Probably the commonest type of calcification in the pelvic region is that which occurs in the vessels.   The appearance of the circular or parallel lines of calcium in the arteries and the multiple, smooth, rounded phleboliths are easily recognized, but the latter must be distinguished from stones in the lower part of the ureters. Another fairly common and characteristic type of calcification is that which is found as a collection of discrete flecks immedi-

ately underlying, or slightly above, the symphysis pubis, and which represents calculi in the prostate gland.   The deposit which occurs in leiomyomas of the uterus is quite characteristic, having the appearance of the imprint of a sponge which has been dipped in whitewash (Fig. 6).   These lesions are commonly multiple and large, and they may extend upward out of the pelvis to the mid-abdominal field (9).   In contradistinction to the smooth walls of cysts of various types, the margins of calcified fibroids are slightly roughened, although generally regularly rounded in outline.

Calcification is a common finding in ovarian cysts, particularly dermoid cysts, in which the presence of teeth is a diagnostic feature.   In addition to the presence of calcium, the identification of dermoid

cysts is facilitated by the sign described by Danelius and by Robins and White, which is found in a large proportion of these tumors (6). Cysts of the ovary are often bilateral, a fact which may be of some aid in their identification, but the position of the cysts is extremely variable. Both ovaries may be found to lie on the same side of the pelvis, or they may be found lying well above the brim of the pelvis. One or both ovaries may prove to be completely calcified without cyst formation and must be distinguished from vesical calculi. Confusion of cysts and complete calcification of the ovaries with deposits of calcium in an old pyosalpinx should be avoided. In the latter, the deposits tend to be more uniformly dense throughout the lesion and of the mottled nature of calcium deposition found in other abscess cavities. The outline of the lesion will probably not present the smooth, regularly circular contour commonly found in association with cysts.

Teratomas showing teeth and bones have been reported in other situations, as in the region of the kidneys, and a differentiation must be made from other types of calcification which may be encountered in these regions. The differentiation of calcium deposits of this type from those found in degenerating malignant tumors should not be difficult. The extensive, elongated, spidery deposition of calcium in lesions of this sort is usually diagnostic, and the lesions may be found in any position in the abdomen.

A common simulant of calcification in the pelvic area is the residue of opaque material such as bismuth which has been injected into the gluteal muscles. The long, multiple, parallel streaks of the injections extend upward and medially from the lateral aspects of the pelvis, and no difficulty should be encountered in their recognition. Similarly the residuum of a lipiodol insufflation of the uterus and fallopian tubes should be readily recognized. An interesting simulant of a calcified cyst was encountered in the roentgenogram of one of our patients, and might

easily have been mistaken for a dermoid cyst. It overlay the pelvic region and presented some of the features of the Danelius and Robins and White sign. It proved to be a paraffinoma of the inguinal canal and the margins of the lesion contained a little calcium. This was the result of a paraffin injection some years previously for the relief of an inguinal hernia.

Some less common types of calcification that may be mentioned are those found in the seminal vesicles and ducts. The position and distribution of these concretions in the mid pelvic area should provide the clue to the diagnosis. Remnants of opaque material remaining after the injection of this part of the genital tract may be encountered also. Rarely, one may find a calculus in the urethra following operations for the correction of congenital defects and injuries. Calcification about the base of the bladder and lower part of the ureters which occurs in schistosomiasis is an uncommon finding in this country, as is the calcification of other parasites which commonly infest man in tropical countries. Occasionally the widespread rice-like calcified bodies of *Cysticercus cellulosae* are seen. A rather uncommon type of calcium deposit, but one which should cause no difficulty in diagnosis, is that which occurs in a retained dead fetus or lithopedion.

It is advisable to obtain two films of the abdomen for the interpretation of intraabdominal calcifications. These may be made for stereoscopic use or with just a slight shift of the tube so that the relative change of position of calcium deposits may be studied. Occasionally it will be found advantageous to obtain a lateral view in addition to the ordinary anteroposterior views, when the nature of the calcium deposit is obscure.

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INTRA-ABDOMINAL HERNIA OR INTESTINAL INCARCERATION: TWO VERIFIED CASES PRE-OPERATIVELY DIAGNOSED

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THIS paper does not present anything original or new. Attention is simply called to a condition which can be diagnosed pre-operatively only by the roentgenologist, but by him very readily recognized. It is usually overlooked and found accidentally at operation or post-mortem, yet the diagnosis is simple and obvious and is missed only because time is seldom taken to outline the jejunum with barium.

This condition has been fully described in the literature and the literature, in turn, has been reviewed several times in recent years, the last review being presented by Alexander, in 1937. Paraduodenal or intra-abdominal hernia was described anatomically by Neubauer, 163 years ago, but the literature since then has not been voluminous. Treitz, in 1857, and Moynihan, in 1899, published monographs covering the condition in detail. A majority of the cases reported have been described by surgeons who have found an intra-abdominal hernia in the course of an operation, usually for small bowel obstruction or suspected appendicitis. In all, only a few over 200 cases of intra-abdominal hernia have been described, and of these only four were diagnosed pre-operatively, that is, by x-ray examination, the only means by which a pre-operative diagnosis can be reached. Kummer diagnosed a left-sided hernia in 1921, Taylor a right-sided hernia in 1930, and Exner one of each, reported in 1933. Alexander reported five cases, in 1937, in which he was able to make the diagnosis, but in none of these was surgery necessary, so that these cases have not been confirmed.

In this communication, two more cases, diagnosed pre-operatively and confirmed, are added to the literature. Both are of the right-sided variety, although only about a third as many have been reported as having occurred on the right side as on the left. One case presents the anatomy usually described in the cases previously reported as paraduodenal hernias, except that failure of descent of the cecum was associated with the hernial sac. In the other case, there was no true hernial sac present. The cecum and ascending colon and hepatic flexure were attached by a true mesentery which formed a sac only when this portion of the colon was carried mesially. But these two cases are presented because basically the anatomic anomaly, abnormal peritoneal folds, is the same, and the diagnosis and treatment are identical with true intra-abdominal hernias.

The exact cause of the occurrence of these peritoneal abnormalities has not been demonstrated. Treitz felt that fossæ about the junction of the duodenum and jejunum were the result of failure of fusion of the peritoneum during the third stage of the process of intestinal rotation. Moynihan thought the fossæ were the result of a failure of fusion of the mesenteric root with the peritoneum covering the posterior abdominal wall. Whatever the cause of these fossæ about the duodenojejunal junction, they were thought to be capable of receiving loops of intestine, gradually enlarging as the result of intestinal activity, thus accommodating more and more loops. Andrews, writing in 1923, refused to accept the concept of a small fossa expanding because, as he said, there is no way for pressure in the hernial sac to be greater than in the main peritoneal space,

so that there is no reason for the expansion of the sac. He also pointed out that the degree of herniation in the cases described has always been nearly total, few cases being seen in which the sac was only partly developed. Even intra-abdominal hernias described in infants have been nearly complete. However, in both of the cases being reported herein, a few loops of jejunum only are involved. Andrews felt that such hernias were the result of abnormal rotation of a loop of gut during the various stages of intestinal rotation in the embryo. Others feel that the formation of the blood supply to the colon during fetal life influences the size and position of the peritoneal folds. But it is not our purpose to go into these theories, which have been fully presented elsewhere. However formed, in the intra-abdominal or paraduodenal hernia, there is an abnormal opening in the region of the duodeno-jejunal flexure leading into a peritoneal sac which is capable of receiving varying lengths of the small intestine. The hernia is not necessarily irreducible, a point which will be developed in connection with one of our cases. The opening into the sac may lead, as it usually does, to the left, with the main portion of the sac lying to the left of the midline. In about one-third of the cases, the sac is to the right. The relation of the sac to the large intestine varies greatly but usually the colon runs around the encapsulated small intestine.

The symptomatology in the reported cases has not been consistent. A majority of the patients presented themselves with acute upper intestinal obstruction. Alexander, whose five cases comprise the largest single group reported, stresses, in the chronic cases, abdominal pain which is exaggerated by exertion, by erect posture, or by eating, and is relieved by reclining, by smaller but more frequent meals, or by food containing a small percentage of roughage.

CASE REPORTS

Case 1. J. H. R., 21-year-old male student, was admitted to the University Hospital on Feb. 27, 1939. He had been in good health up until a month previous to admission, when he first noticed a well localized burning epigastric pain which came on from one and a half to two and a half hours after eating and which lasted until the next meal was taken. This pain was relieved by soda. He was told by the student physician that he probably had a peptic ulcer and was put on a five-meal gastric diet. This was followed by marked improvement up until one week before admission, at which time the pain had
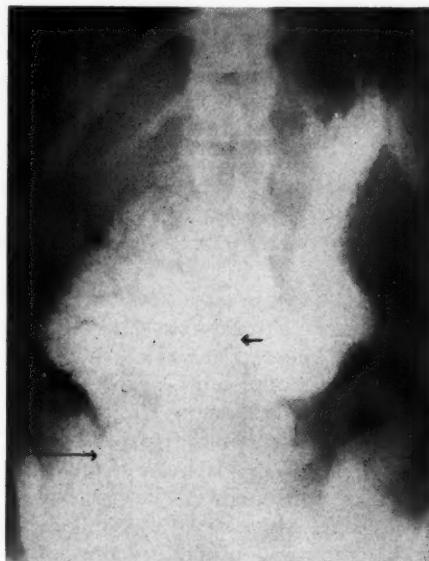
Fig. 1.   Case 1.   For description see text.

returned and had grown steadily more persistent and severe. It radiated to the umbilicus, was almost constant, and could not be relieved. Three days before his admission, the patient became nauseated and vomited food recently eaten. After that he ate practically nothing because of both nausea and anorexia. Vomiting did not recur. Bowel movements were regular. There was no hematemesis, diarrhea, tarry stools, jaundice, or acholic stools. The weight on admission was 173 pounds, a loss of 12 pounds having occurred in two months in spite of an adequate diet. There was no loss of appetite

until the episode of nausea and vomiting three days prior to admission.

A gastro-intestinal series was done the day of admission, and the report was as follows: "The esophagus was normal. The stomach (Fig. 1) and duodenal bulb were pushed to the left of the midline. Otherwise the stomach was negative. The second portion of the duodenum was stretched out toward the right but otherwise the duodenum appeared normal. As soon as the opaque material entered the jejunum, many loops of small bowel were seen in a roughly rounded area, 12 cm. in diameter, which corresponded to the pressure defect on the stomach. There was a lapse of several minutes before any of the opaque material passed through this area. Distribution of the rest of the small bowel was normal. Six- and 24-hour examinations were essentially negative.

"Conclusions: Right paraduodenal hernia."

The abdomen was explored on the following day. The surgeon, C. Bruce Morton, M.D., made the following operative note: "No abnormalities were found in the stomach, duodenum, or gall bladder. When the region of the suspected hernia was explored, the presence of an internal concealed paraduodenal hernia was corroborated. There was a peculiar peritoneal anomaly, probably congenital in origin, whereby the cecum had apparently failed to descend in the right lower quadrant of the abdomen. The cecum was adherent almost at the ligament of Treitz and the appendix curved over and entered the internal hernia, together with loops of the first portion of the jejunum. There was a pocket bounded above by the ligament of Treitz, anteriorly by the superior mesenteric vessels, below by the cecum and its peritoneal attachments, and behind by the parietal peritoneum. Through this opening several loops of the first portion of jejunum had passed and had lodged in a sac which readily permitted the introduction of a man's fist after the intestines had been removed. It was evident that this was the explanation for the patient's x-ray findings and for his symptoms. It was not a difficult procedure to remove the loops of intestine from the pocket, and then, in order to expose the region satisfactorily, it was necessary to eviscerate the patient as far as the small intestine was concerned. Sutures were then placed in and out, beginning behind and going through the sac and coming out in front, very much in the manner of an obliterative endo-aneurysmorrhaphy. When a sufficient number of sutures had been placed, they were all tied and served to obliterate the peritoneal sac and thereby prevent further loculation of intestinal loops. Nothing else abnormal was found in the abdomen and the incision was closed without drainage. The patient stood the procedure beautifully and was returned to his room in good condition."

This patient has been seen since operation and, to date, has had no recurrence of his trouble. This is a typical example of a right-sided intra-abdominal hernia.

Case 2. E. V. S., also a 21-year-old student, was admitted in November, 1934. He had been feeling well until 15 days prior to admission, at which time he developed a headache, with sharp pain in the epigastrium, coming on several hours after eating and disappearing before the next meal. The past history revealed similar attacks without nausea or vomiting over a period of two years. Roentgen examination was reported as follows on Nov. 28, 1934: "The esophagus was normal. The stomach filled readily and showed rather marked hyperperistalsis. There was such an extreme degree of pylorospasm that none of the opaque material could be expressed into the duodenum for a considerable period of time. After a lapse of approximately thirty minutes, the patient was re-examined and the stomach was thought to be normal except for pylorospasm. The antrum and duodenum pointed directly backward, although the patient was of slender build. The duodenum was well filled and was normal. There were many coils of jejunum matted together in a somewhat rounded area, about

13 cm. in diameter, below the liver and to the right of the midline (Fig. 2). At this time no other small intestinal loops were seen in the abdomen.

"Six-hour examination showed a large gastric residue estimated at about 50 per cent of the ingested meal. The rest of the barium was scattered through the small

stalsis. The patient was examined in the erect position for several minutes and none of the opaque material was seen to pass beyond the ligament of Treitz during this period (Fig. 3). After the patient was placed horizontally on his abdomen, the material flowed rapidly into the jejunum, which showed a normal pattern

Fig. 2. Case 2: Coils of jejunum matted together in a rounded mass below the liver and to the right of the midline.

Fig. 3. Case 2: Roentgenogram taken in erect position nine days after Fig. 2. Opaque material did not pass beyond the ligament of Treitz.

intestine, which was distributed about the abdomen. Twenty-four-hour examination gave no additional information.

"Conclusions: Marked degree of pyloro-spasm, possibly with hypertrophy of the musculature. The loops of jejunum and the position of the duodenum are believed to represent a paraduodenal hernia."

Nine days later the patient was re-examined and the following report was made: "The pylorus was very much less spastic than at previous examination. The duodenum was filled, was very long and wide, and showed much reverse peri-

throughout the abdomen. There was no collection of loops such as was noted on the first examination.

"Six-hour examination showed the stomach to be entirely empty, with the head of the meal in the hepatic flexure.

"Conclusions: Marked chronic duodenal obstruction. On account of the normal pattern of the jejunum at this time, it is believed that the possibility of paraduo-denal hernia has been eliminated. It is thought, however, that there must be an anomaly, such as a fossa, into which the bowel can go and later be released."

On the following day, the abdomen was explored by C. Bruce Morton, M.D., whose operative note is again quoted: "No evidence of an internal hernia was discovered. The cecum, ascending colon and hepatic flexure of the colon, however, were found to be attached by a true mesentery approximately 15 cm. in length. This made the parts of the colon mentioned very mobile. When the ascending colon was carried mesially, a large pocket was formed in the right upper quadrant of the abdomen corresponding to the point at which roentgenologic examination had revealed an apparent incarceration of the jejunum. It seemed probable that the jejunum was in this position at the time of the first examination. Further exploration of the abdomen revealed no abnormalities of any of the intra-abdominal organs except the duodenum. The second portion of the duodenum was quite redundant and a pendulous sacculation of the duodenum was evident caudal to the attachment of the transverse mesocolon. This finding was typical of previous cases of chronic duodenal obstruction, encountered at operation and treated with very satisfactory results by duodenojejunostomy. The appendix was removed as a routine measure and the cecum and ascending colon were then sutured into normal position by several interrupted sutures of fine silk which were used to obliterate, to some degree, the long mesentery of the ascending colon. At the conclusion of this procedure, the cecum and ascending colon seemed to be satisfactorily fixed in normal position. The first portion of jejunum was then approximated to the saccular portion of the duodenum and a small anastomosis made. The stoma was approximately the size of the lumen of normal jejunum."

This patient, now in medical school, has had no recurrence of his symptoms. While this was not in the true sense an internal hernia, the mechanics of obstruction and the roentgen appearance are identical with hernia, except that re-examination failed to show the loops incarcerated in the sac formed by the mesentery. At this time the loops had apparently become dislodged.

DISCUSSION

From reviewing the literature and restudying our two cases, the symptomatology is not extremely obvious. At present, in all of our gastric examinations, when there is a history of discomfort following eating after an interval of an hour or so, unrelieved by soda, particularly associated with nausea or vomiting, with no demonstrable lesion in the esophagus, stomach, or duodenum, we take films at hourly intervals until the entire small intestine has been outlined. If on any of these films there is a suggestion of matting together of loops, we examine the patient fluoroscopically to determine whether or not there is fixation of the coils.

The second case suggests the advisability of study in an attack, if this is possible, for apparently the incarceration in the false sac was self-reducible in this particular case. During the second examination the intestine was in its normal position, this being prior to operation. It should also be noted that in this case on the initial examination with the small bowel incarcerated, there was a 50 per cent six-hour residue. On the second examination ten days later with the small bowel showing a normal pattern, there was no residue.

Alexander has brought out the possibility of mistaking a matting together of bowel by adhesions for an intra-abdominal hernia and states that the history of previous operations is of help in differentiating the two. Perhaps the differentiation cannot be made pre-operatively, but if the patient's symptoms warrant surgical relief, the internal mechanism is really the same, whether the matting together is due to incarceration in an internal hernia, a false sac formed by a long mesentery, or by a sheet of adhesions. Also, the treatment is the same, namely, releasing the bowel.

We believe that there must be many cases, similar to those reported, which remain undiagnosed, for the conventional, short initial examination, followed by a

second at the end of six hours, leaves the small intestine relatively unexplored. Only by more careful examination of the small bowel at frequent intervals in selected cases and by noting fixed clumped coils of intestine, may we recognize these. Furthermore, it is believed that many more diagnoses will be made if such patients are examined during an attack.

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DISCUSSION

B. R. KIRKLIN, M.D. (Rochester, Minn.): Among surgically confirmed instances of paraduodenal hernia observed at the Mayo Clinic, three were noted during the past two years. In the first of these cases, radiologic examination disclosed a huge ulcerating carcinoma obstructing the outlet of the stomach, and the small bowel was not visualized. At operation, after resection of the carcinomatous portion of the stomach, a paraduodenal hernia which included almost the entire small bowel was reduced.

In the second case the radiologist noted displacement of the duodenum to the right but no further data were recorded. On surgical exploration, several small loops of small bowel were found to have entered the retroperitoneal space through an opening near the ligament of Treitz.

In the third case radiologic examination was more decisive than in the other two, for several barium-filled coils of small bowel were closely packed together slightly to the left of the midline of the abdomen and the picture was virtually pathognomonic.

At operation it was found that the ligament of Treitz was absent and a malformation of the peritoneum at this point had permitted herniation of the entire jejunum into the retroperitoneal space.

The hernia was reduced and the sac was obliterated by a continuous suture.

I agree with Dr. Cooper in his opinion that in most instances of paraduodenal hernia a specific radiologic diagnosis can be made and that probably many cases are overlooked through failure to examine the small bowel.

I wish to congratulate the authors for their recognition of the two cases reported.

LEO G. RIGLER, M.D. (Minneapolis, Minn.): Because the cases mentioned by Dr. Cooper were reported from my department when Dr. Exner, who is now practising in Seattle, was working there, I have some familiarity with the subject.

I might say that since his report we have seen one other case which we have not recorded.

There are only one or two points I want to add to what Dr. Cooper has said. One is that the cases which we have seen, as Dr. Cooper has so well brought out, have been found, not because of any clinical suspicion, but because of observation of the distribution of the coils of the small bowel.

The second is that we have had difficulty in distinguishing between a simple congenital non-rotation of the small bowel and an actual herniation. There is a relationship, of course, but the anomaly in which

the colon lies entirely on the left side and the small bowel entirely on the right side is not a rare occurrence. Most of us have seen it frequently.

We have been astonished to find that in a few cases of non-rotation there was a sac at operation which looked very much like a hernial sac although it was not a true hernia.

I might point out one more thing so far as the differential diagnosis is concerned. We found the examination in the upright position to be of great value. Dr. Cooper showed quite well the coils of bowel obviously enclosed in some sort of sac, yet one might hesitate to be sure they were so enclosed unless the patient was put in the upright position and the coils were found to maintain themselves in the same position; in the cases we had, with much more of the small bowel involved, we found that maintenance in the upright position was of considerable value in fortifying ourselves as to the diagnosis.

HEPATIC DUCT VISUALIZATION FOLLOWING ORAL CHOLECYSTOGRAPHY[1]

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From the Department of Radiology, The Mount Sinai Hospital

VISUALIZATION of the cystic and common ducts can be accomplished regularly if a suitable meal is administered following cholecystographic visualization of the gall bladder (7). This occurs presumably as the result of contraction of the gall bladder and simultaneous relaxation of the sphincter of Oddi. Visualization of the hepatic duct system above the junction of the cystic and common ducts is unusual. The present report is of four such cases. There have been few reports made previously and none has been found since that of Bronner (15).

A brief review of biliary physiology reveals that the following are more or less accepted principles. The gall bladder and the bile ducts are supplied with elastic tissue. In addition, the gall bladder has a muscular coat, the fibers of which are arranged to facilitate concentric contraction (1). It is generally conceded that there is a sphincteric action, if not a definite muscular sphincter, at the choledocho-duodenal junction (2).

The muscles are innervated by both the vagus and the splanchnic nerves (3). In a manner similar to that found in the enteric canal there is a reciprocal innervation of the muscle of the viscus and that of the sphincter, so that when the gall bladder contracts, the sphincter of Oddi relaxes (4).

The liver is capable of excreting bile at a maximum pressure of from 270 to 300 mm. of water. When the pressure in the ducts rises to the level of 50 to 70 mm. of water, the cystic duct, and then the gall bladder, fills. The sphincter of Oddi maintains normally a tonic contraction

capable of withstanding an intraductal pressure of 150 mm. of water (8). It is this tonic contraction which enables the gall bladder to fill. When the ducts are distended with a pressure of from 250 to 300 mm. of water (the maximum pressure which the contracting gall bladder may exert), pain results (5). While the contraction of the gall bladder will normally force bile through the sphincter, bile cannot be forced up the hepatic ducts against the greater secretory pressure of the liver (14).

It follows, therefore, that reflux into the hepatic duct as an explanation for its visualization is unlikely unless there is an imbalance in the reciprocal innervation mechanism which permits spasm of the sphincter of Oddi while the gall bladder is in contraction. There are ample clinical and experimental observations to support this (10, 11, 12). Bronner (15) reported four cases of peptic ulcer in which visualization of the hepatic ducts was noted. Although he states that Schöndube considered this as normal, Bronner could demonstrate the phenomenon in only one of fifty normal cases, and that in a patient with so-called cervical neuritis. Boyden (16) showed a similar finding in a cat.

Naturally the question arises whether or not this phenomenon is to be associated with the clinical syndrome of biliary dyskinesia. Although the syndrome has been discussed extensively (6, 9, 13), the clinical diagnosis is a difficult one to sustain in the absence of manometric studies following choledochostomy. Too often, subsequent examination or operation reveals a small calculus as the cause of the symptoms. Hence the available data do not permit direct correlation, although the association of hepatic duct vis-

Fig. 1.   Case 1:   Examination made 10 minutes after the administration of three egg yolks. Black arrow points to hepatic duct.

Fig. 2.   Case 3:   Examination made 10 minutes after the administration of three egg yolks. Arrow points to hepatic duct.

ualization and symptoms which may be interpreted as dyskinesia is certainly highly suggestive.

The following are reports of the cases which have come under our observation. The cholecystographic technic used has been described previously (7).   Ten grams of tetraiodophenolphthalein are administered in two 5-gm. doses for visualization of the gall bladder.   Roentgenograms are made 15 and 35 minutes after the administration of three egg yolks.

Case 1[2] (Fig. 1). A. J. (No. 4,174. 1939), aged 54, was a married white female, complaining chiefly of nausea and vomiting of three weeks' duration.   The family history was non-contributory.   Her past history revealed that she had been generally healthy.   She had had a pelvic laparotomy in 1929, at another hospital.   There had been eight pregnancies.

One week before admission the patient developed mild intermittent pain in the right upper quadrant, which radiated around to the back.   There was no jaun-

dice.   There were no clay-colored nor tarry stools.

On physical examination the pertinent findings were confined to the abdomen. A long midline scar was present.   A questionable, irregular, nodular mass was palpable in the right upper quadrant.   No tenderness was elicited.

An x-ray examination of the gastrointestinal tract, three days after admission, failed to reveal any evidence of an organic lesion.

Aside from a very low free and moderately low total hydrochloric acid in the fasting gastric contents, laboratory examinations revealed no abnormalities.

Case 2 (The Mount Sinai Hospital, Consultation Service).   H. M., white male, aged 47, complained of sticking pains in the right upper quadrant for three years, and shortness of breath for the same period of time.   An appendectomy was performed 10 years ago.   Cholecystography performed elsewhere was reported as showing a normal gall bladder without stones.   Physical examination revealed no abnormalities.

Laboratory studies yielded the following results: There were normal red and white cell counts, with a normal differential.   The Kahn test was negative.   The urine was entirely normal.   The stool was also normal.   The basal metabolic

rate was plus 1. The Rehfuss test meal showed anacidity, with acid appearing after the administration of histamine. Fluoroscopy of the stomach and duodenum failed to elicit any abnormalities.

Cholecystography visualized the common hepatic duct after ingestion of the fatty meal. The gall bladder was found to be normal in size, shape, and position. No calculi were demonstrated.

Case 3. A. K. (Out-patient Department. No. 33-4974.), aged 51, white married female, complained of dizziness, occasional vomiting, attacks of "gas," epigastric pain, and nausea for as long a time as she could remember.

Physical examination revealed no abnormalities in the abdomen.

No laboratory studies were performed. Cholecystography visualized the common hepatic duct after ingestion of the fatty meal. The gall bladder was found to be normal in size, shape, and position. No calculi were demonstrated (Fig. 2), Repetition of the examination about six weeks later resulted in the same findings.

Case 4. B. P. (Out-patient Department. No. 33-295.) complained of epigastric pain unassociated with the ingestion of food but radiating to the right shoulder. The duration of symptoms was three years.

Physical examination failed to reveal any abnormalities. Biliary drainage in January, 1940, showed an occasional white blood corpuscle and an occasional cholesterol crystal.

Cholecystography visualized the common hepatic duct after ingestion of the fatty meal. The gall bladder was found to be normal in size, shape, and position. No calculi were demonstrated.

SUMMARY

1. Four cases are reported in which after cholecystography and the ingestion of a suitable meal, the cystic, common, and hepatic ducts were outlined.

2. This finding is considered as possibly abnormal and presumably due to a disturbance in the reciprocal relationship of gall-bladder contraction and relaxation of the sphincter of Oddi.

3. The clinical symptoms in these cases are similar to those described as forming the syndrome of biliary dyskinesia. However, without cholangiographic confirmation, this clinical diagnosis cannot be established and a definite correlation cannot be made.

4. It is possible, however, that the roentgen finding described should be considered as offering confirmatory evidence of the diagnosis of biliary dyskinesia.

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CARCINOMA OF THE JEJUNUM[1]

By M. J. GEYMAN, M.D., *Santa Barbara, California*

CARCINOMA of the jejunum is sufficiently rare to justify the report of a single case, particularly when the roentgen findings allow a preoperative diagnosis. Most carcinomatous lesions of the small intestine occur in the proximal portion, more often in the duodenum. No definite etiologic factors are apparent in the cases reported.

are usually adenocarcinomas. Metastases occur late in most cases and are due to lymphatic extension to mesenteric and retroperitoneal nodes. Later metastases are found in the pancreas, liver, lungs, and long bones. The annular type of tumor shows an early infiltration of the submucosa, and ulceration with secondary
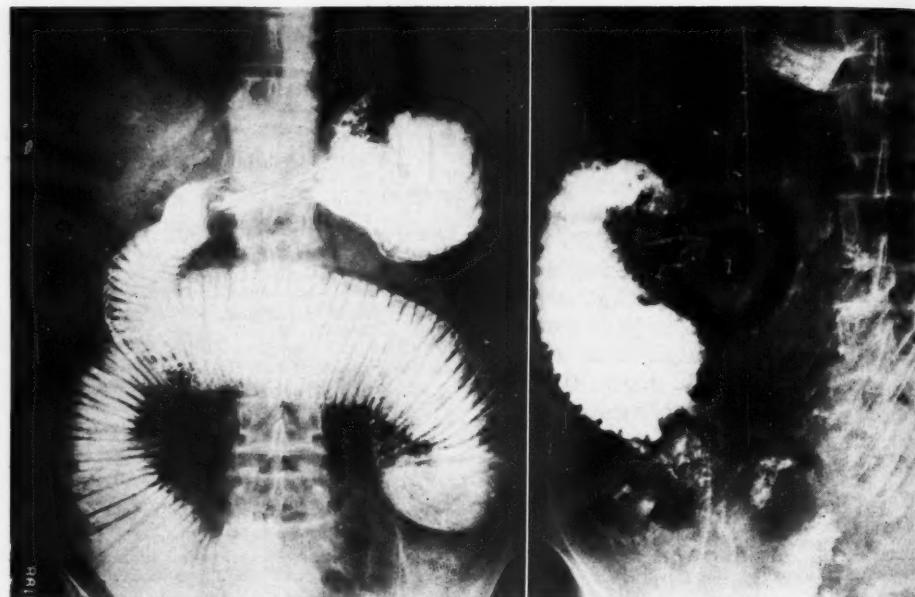
Figs. 1. and 2. Carcinoma of jejunum: roentgen appearances

Age incidence averages around fifty years. A casual perusal of the literature discloses about one hundred cases.

Pathologically, the polypoid stenosing type predominates over the annular by a ratio of three to one. Histologically, these

infection is a common complication. Perforation is rare. Intussusception occurs occasionally.

The clinical symptoms depend on the degree of obstruction caused by the lesion. Occasionally a secondary anemia is the predominant manifestation. Balfour and McIndoe report a case of secondary anemia with recurring intestinal hemorrhage. The duration of the clinical symp-

toms was six years, hemorrhage occurring four, three, and two years before operative exploration and diagnosis.

Roentgen findings in jejunal carcinoma are usually proportionate to the degree of obstruction present. A lesion too small to produce obstruction is difficult to detect. Lymphosarcomatous tumors, while they do not tend to produce obstruction, offer a larger intraluminal mass and are, therefore, more possible of roentgen detection when no obstruction exists.

CASE REPORT

A woman, 61 years of age, was referred for roentgen study. She complained of indigestion for the past year, loss of 11 pounds in weight, and abdominal distention with cramps for six weeks. Immediately previous to admission there was occasional vomiting. Physical examination revealed visible peristalsis in the upper abdomen.

Roentgen Findings.—The colon was studied first with a barium enema and was found to be negative. Films of the colon showed faint gaseous outlines of small bowel pattern in the upper abdomen. The following morning barium was given in fractional doses by mouth. The stomach was high in position, of normal size, and showed no structural abnormality. The duodenal cap was of normal size and was not deformed. Beyond the cap the duodenum was widely dilated. The jejunum showed the same degree of dilatation to a point about thirty inches beyond the duodenojejunal junction, where the pattern changed abruptly, a ring-like stenotic deformity marking the transition from wide to normal caliber (Figs. 1 and 2). Five hours later the stomach was empty except for a trace. Most of the opaque material was in the jejunum, only a small amount having passed the obstruction.

Roentgen Diagnosis.—Obstructing lesion of the jejunum, most likely carcinoma.

After decompression by Miller-Abbott tube, the patient was operated upon and a small annular tumor was found at the site

of roentgen localization. This was removed, together with a hard mesenteric lymph node one inch from the lesion. No other nodes were found. The liver was grossly normal. The jejunum proximal to the obstruction was hypertrophied. The patient died a day following surgery, presumably from cardiac disease.

Pathologic Report (Dr. Clark E. Brown). —A segment of jejunum, 30 cm. long, with a portion of the mesentery attached (Fig. 3). The width of the mesentery at its upper end is 2 cm., in its mid-portion 5 cm., and in its distal portion 2 cm. At a

Fig. 3. Segment of jejunum showing obstruction due to carcinoma.

point 5 cm. from the lower end of the specimen there is a hard napkin-ring constriction in the bowel wall. This is caused by a hard gray tumor apparently arising just beneath the mucosa and extending outward to the serosa. The tumor is 2 cm. long and completely annular. The mucosa seems almost intact over the surface of the tumor. The tumor is so completely obstructing that water will not pass through the lumen. The diameter of the bowel above the tumor is 5 cm., and the mucosa is markedly hypertrophied. Below the tumor the jejunum is 2.5 cm.

in diameter, and has a thin wall. At one point the tumor has penetrated the serosa to appear as tiny hard white nodules. Two lymph nodes adjacent to the tumor in the mesentery are replaced with dense, hard white tissue. At the line of excision of the mesentery, there are some hemorrhage and induration of the fat.

Microscopic Examination.—The mucosa is replaced by masses of columnar and cuboidal tumor cells arranged as distorted acini and sometimes as solid plugs. The tumor cells are hyperchromatic and contain secretion vacuoles. Mitotic figures are rarely encountered. The lymphatics are invaded by nests of tumor cells which extend to the serosal surface. No intravascular invasion is noted. Section through the adjacent mesenteric lymph nodes shows numerous clusters of tumor cells.

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DISCUSSION

B. R. KIRKLIN, M.D. (Rochester, Minn.): Case reports of cancer of the jejunum such as this one presented by Dr. Geyman are interesting because cancer in this part of the alimentary canal is relatively rare and because its radiologic diagnosis has made definite progress in recent years. At present the difficulty is not so much to disclose the lesion as to determine when the small bowel should be inspected, for the examination is time-consuming and can scarcely be applied as a routine.

Usually the symptoms and signs, such as vomiting, hemorrhage, and pain, are logically attributable to other affections, especially to duodenal ulcer, and jejunal cancer will too often not be taken into account.

Among a considerable number of cases observed at the Mayo Clinic, I recall one in particular which shows how deceptive the clinical manifestations may be. The patient, a woman aged 67 years, had had several attacks of vomiting during the four months before she came to the Clinic. A standard examination of the alimentary canal by a thoroughly competent radiologist at the time of onset of symptoms had given negative results, and, as most of the attacks had followed periods of emotional stress, it was doubted that the vomiting had an organic basis.

At the Clinic, radiologic examination failed to reveal any lesion of the stomach or duodenum, but cholecystographic examination disclosed the presence of gallstones.

On radiologic re-examination directed particularly to the small bowel, a small annular carcinoma was found in the distal part of the jejunum, with marked dilatation of the bowel proximal to the growth. When excised the tumor proved microscopically to be an adenocarcinoma.

Dr. C. W. Mayo, shortly before his death in 1939, reviewed the records of all malignant lesions of the small bowel observed surgically at the Clinic and found that the growths were situated in the jejunum, duodenum, and ileum in that order of incidence.

Histologic study of those located in the jejunum revealed that adenocarcinomas were markedly preponderant, accounting for 90 per cent; slightly less than 7 per cent were leiomyosarcomas.

This paper should help to make radiologists more keenly conscious of the potential existence of lesions in the small bowel, not only tumors but also various inflammatory states. With the newer technics, affections which alter the internal relief of the bowel can usually be discovered and many of them can be identified.

RADIOBIOLOGIC ACTION AND THE KILLING EFFECTS OF X-RAYS ON ACHROMOBACTER FISCHERI[1]

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PART I: HISTORICAL

HOW cells respond to an external lethal agent, regardless of its character, has been a matter of interest for many years. It is natural that pharmacologists, being concerned with the therapeutic and germicidal action of chemical substances from the advent of the scientific treatment of disease, should have been the first to deal with the quantitative aspects of the cellular reactions to injurious agents.

Graphs arranged to show the variation in amount of biological effect—usually the percentage of cells or bacteria killed—with the concentration of drugs applied, give two general types of curves, those which have a definite threshold character (Fig. 1, II) and those which do not (Fig. 1, I).

Pharmacological Experiments.—As early as 1905, Henri suggested that the non-threshold type of curve represents a mono-molecular reaction, that is, one in which one molecule of the affecting agent reacts with a cell in a manner to cause death, and that the threshold type must represent a multimolecular response, or one in which two or more such events occur. Other evidence was accumulated in line with this view (Salomonsen and Dreyer, 1907; Dreyer and Hanssen, 1907), but Madsen and Nyman, 1907, were the first to make any attempt at applying a mathematical analysis to the quantitative data obtained and to determine whether the responses were monomolecular or multimolecular. These authors made use of the mass action law and found that certain of their survival curves conformed in a general way with

the exponential type. This led to an extended analysis of similar data obtained by others (Chick, 1908; Paul, 1909; Harvey, 1909; Reichenbach, 1911; Eijkman, 1912; Peters, 1920), but no convincing results were obtained during this period, due largely, it seems, to complexities of cell membranes, which con-
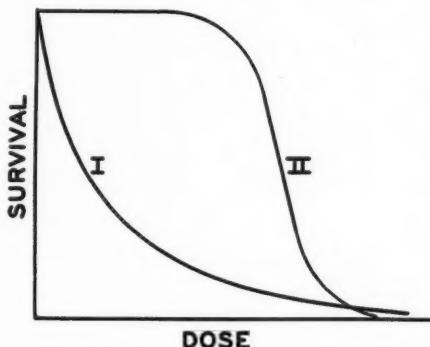
Fig. 1. Curves showing how biological effect varies with the dose of the agent applied.

tinuously interpose penetration barriers and thus prevent a clear understanding of the quantitative relationships of the substances acting with those being acted upon. Even more recent work in this field (Clark, 1933; Rahn, 1934) has not completely avoided these difficulties.

Radiobiological Experiments.—It is of particular interest to note that radiation, an agent to which cell membranes offer no appreciable resistance, was not employed for a study of injury effects in cells during the period from 1907 to 1920, even though the nature of these reactions was under enthusiastic investigation by many workers (Table I). It is also of interest that radiobiologists, who during this period were concerned with the question of how radiations affect cells, did not make use of the ideologies and practical procedures be-

TABLE I.—CHRONOLOGICAL ARRANGEMENT OF PAPERS ON CELL RESPONSE TO LETHAL AGENTS

Year	Pharmacological	Radiobiological	Radiogenetic
1905	Henri: Suggested monomolecular relationship between drug action and cell response		
1907	Salomonsen and Dreyer		
1907	Dreyer and Hanssen		
1907	Madsen and Nyman: First applied mathematical analysis to quantitative data		
1908	Chick		
1909	Paul; Harvey		
1911	Reichenbach		
1912	Eijkman		
1920	Peters		
1921			Mavor: Demonstration of chromosomal changes produced by x-rays
1922		Dessauer: Direct hit (point-heat) theory. Blau and Altenburger: Applied mathematical formulation to direct hit theory	Mavor: Non-disjunction produced by x-rays
1923			Mavor: Linkage and crossing-over influenced by x-rays
1924		Crowther: Determined size of sensitive region	Mavor: Production of gynandromorphs with x-rays
1925		Holthusen: Criticism of hit hypothesis (1925–1928)	
1926		Crowther: Colpidium work	
1927		Condon and Terrill: Suggested that cell injury is produced by the quantum as a unit	Muller: Artificial transmutation of the gene. Gager and Blakesley: Gene mutations produced with x-rays
1928		Zuppinger and Meissner: Altered the formulae of Blau and Altenburger to allow for biological variation	Stadler: Induced mutation and relation to dormancy, temperature, and dosage. Hanson: Proportionality curve for production of mutation with x-rays
1929		Curie; Holweck and Lacassagne: Continued discussion	

ing developed in connection with pharmacological studies.

So far as we are aware, the first to inquire into the exact nature of the lethal action of radiation on cells was Dessauer, who in 1922, reasoning from the fact that the absorption of radiation is discontinuous in nature, proposed that this agent probably acts photochemically on discrete entities within the cell, the injury of which causes death. In such a case only the radiation absorbed in these entities has a significant effect ("point-heat-hypothesis"), whereas that which is absorbed elsewhere contributes little or nothing to the lethal action. This idea was subse-

quently elaborated by others and has been referred to by such names as *specific-action hypothesis, target hypothesis, impact hypothesis, hit theory, bomb theory*, etc. As will be shown below, there developed in contrast to this view the idea that the significant action of the radiation was not on specific entities in the cell but that the effects were more general in nature. This notion has been referred to simply as *general-action theory, theory of total absorbed energy, poison theory*, etc.

In the same year that Dessauer's original article on this subject appeared, Blau and Altenburger, at his suggestion, published a detailed mathematical formula-

TABLE I.--CHRONOLOGICAL ARRANGEMENT OF PAPERS ON CELL RESPONSE TO LETHAL AGENTS—*Cont.*

Year	Pharmacological	Radiobiological	Radiogenetic
1930		Wyckoff: Discovery of exponential killing curves; showed independence of wave length	Muller: Review and analysis of previous work Timofeeff-Ressovsky: Mutation of the gene in different directions
1931			Timofeeff-Ressovsky: Review and analysis
1932	Rahn: Monograph	Glocker: Hit consists of electron passage through sensitive region	Oliver: Time factor during treatment
1933	Clark: Monograph		Gowen and Gay: Gene number, kind, and size in *Drosophila*
1934	Rahn: Review	Mayneord: Further contribution to Glocker's development	Timofeeff-Ressovsky: Independence of wave length, temperature, fractionated doses, shape of mutation curve
1935			Timofeeff-Ressovsky and Zimmer: Independence of wave length and time factor
1936		Lea, Haines, and Coulson: Exponential killing curves for bacteria	Wilhelmy, Timofeeff-Ressovsky, and Zimmer: Mutations due to x-ray action directly on chromosomes
1937		Failla: Fluid-flow hypothesis Scott: Review Lea, Haines, and Coulson: Time factor influence, wave length independency Hercik: Exponential killing curve for bacteria	
1938		Crowther: Theoretical review of biological action of radiation	Zimmer and Timofeeff-Ressovsky: Comparison of x-ray and neutron effects
1939		Goodspeed and Uber: Theoretical review of radiation and cytogenetics	Muller: Discriminatory effects of ultra-violet radiation on the production of mutations

tion of the quantitative relationships between the dose of radiation applied and the amount of biological change observed that would be expected on the basis of Dessauer's hypothesis. This formulation embodies the same basic concept as that of Madsen and Nyman, 1907, that is, the principle of the mass action law. As in the case of Madsen and Nyman, the validity of the development rests upon one basic premise, namely, that the variation in response of individual cells in a sample (as illustrated by Curve II, Fig. 1) is due to the chance encounter of the radiation quanta and the sensitive regions of the cells. This assumption was not received without opposition, since many biologists were inclined to regard the variation in resistance which cells manifest to destructive agents as a biological variation in vitality or the ability to resist injurious agents.

Proceeding from the assumption that biological variation did not exist and that the character of the reaction was determined by the chance encounter of the energy quanta and the sensitive cell regions, Blau and Altenburger were able to calculate, from the shape of the dose-effect curve, the number of effective events, or *hits*, which must occur in the *sensitive spot* to bring about the lethal effect. It is clear that the simplest possible type of reaction of this kind is one in which only a single hit is required to produce cell death. Such a reaction would result in a curve which is exponential in character, as illustrated by Curve I, Figure 1. Those which require more than a single hit give rise to a skew type curve, as illustrated by Curve

II Figure 1, the threshold being determined by the number of quanta required. Because reliable quantitative data had not been accumulated to show how the killing of cells varied with the dose of radiation applied, the development at this stage was entirely theoretical.

The polemic nature of the subject, however, is evidenced by the interesting exchange of papers between Dessauer and Holthusen between 1925 and 1928. While both authors agreed as to the discrete action of the radiation, Holthusen felt that cell injury must be attributed rather to general photochemical change within the cell than to the action on a specific part.

Crowther, without reference to previous work, presented experimental studies of the killing action of radiation on tissues in 1924, and on the protozoon *Colpidium colpoda* in 1926. He obtained a curve which showed a large threshold effect and, by formulating an expression essentially the same as that developed by Blau and Altenburger, calculated the number of hits necessary to kill the organisms. By sufficiently restricting the wave length of the radiation employed and accurately determining the required dosage to produce killing, in ion pairs per unit volume of tissue, he was able to calculate the volume of the sensitive region. This he found to be considerably less than the total volume of the cell, a finding which caused him to emphasize that cells must have certain particular localized regions which constitute the sensitive portion. Crowther's development, like that of Blau and Altenburger, was based on the tacit assumption that biological variation in susceptibility of organisms to radiation does not exist, and that the skewness of the curve obtained is thus due to the number of hits required and the random encounter of sensitive regions and effective units of radiation.

Zuppinger, 1928, realizing that the skew character of the survival curves could be due to biological variation as well as to physical probability, undertook to improve the mathematical expression of Blau

and Altenburger and of Crowther by combining these two factors. With the new formula, the calculated curve was found to fit the experimental data of Crowther even better than the one which he had himself calculated.

Further experimental evidence and discussion supporting the specific action hypothesis were presented by Condon and Terrill in 1927, Curie in 1929, Holweck in 1929, and Lacassagne in 1929 and 1934. Little further development of the specific-action theory was evidenced, however, until 1930, when Wyckoff, studying the killing action of soft x-rays, cathode rays, and ultra-violet light on bacteria, obtained survival curves which manifested no apparent threshold effect and followed an exponential course. Thus, for the first time, experimental evidence of a *single hit killing curve* had been obtained. This was most opportune for the hit theory and put at rest the uncertainties associated with biological variation in susceptibility, inasmuch as the curves lack completely the skew character. This, coupled with the fact that radiation acts discretely on matter, offers strong experimental evidence in support of the specific hit mechanism in the killing of cells by radiation.

Wyckoff presented exponential killing curves (x-ray data) for two forms of bacteria (*B. coli* and *B. aertryke*). Four similar curves have been obtained since, three by Lea, Haines, and Coulson, 1936 (*B. mesentericus*, *B. coli*, *Staphylococcus aureus*), and one by Hercik, 1937 (*B. megatherium*).

It is interesting in this connection to find that, although the specific-action theory was frequently criticized, no serious attempt was made to develop a theory involving general action until 1937. Failla in that year published his theory on the biological action of ionizing radiations. After pointing out that we are here concerned with "radio ions" rather than electrolytic ions, he reasoned that the distribution of radio ions and photochemical products, with respect to membranes of cytological structures involved, may be

responsible for the changes which develop. Thus where circulation or other factors are present to modify the concentration of photo products differentially on the two sides of membranes, movement of fluids through the membranes occurs, causing a change in cell properties, producing swelling, distortion, changes in permeability, viscosity, etc., to such a degree that injury and death result. In such an event the course of the curves, such as those in Figure 1, must be associated with the rate of accumulation of effective amounts of the newly formed photo products. As yet, however, only a small amount of evidence has been assembled in support of what Failla has called the *fluid-flow theory*.

Radiogenetic Experiments.—As indicated, the problem of cell injury and cell death has been pursued along two quite independent lines, pharmacological and radiobiological. Still a third approach has been made, also quite independently. Students of genetics, in an attempt to find ways and means of influencing the hereditary substances of cells, took advantage of radiation as a tool for performing operations of ultramicroscopic fineness and the logical development of this procedure gave rise to the science of radiogenetics.

Mavor in 1922 (and in later years) successfully demonstrated that x-rays influence hereditary behavior in *Drosophila*, and Muller, in 1927 (and subsequently), that the rate of mutation in these forms can be modified. Stimulated by these discoveries, a number of investigators (Hanson and Heys, 1928, 1931, 1932; Oliver, 1932; Gowen and Gay, 1933; Pickhan, 1935; Timofeeff-Ressovsky *et al.*, 1929–1938) undertook to determine the quantitative relation between dose of radiation applied and the number of mutations produced. Analysis of the data disclosed that in all cases the effect was nearly proportional[2] to the dose of radiation and indicated clearly that no appreciable threshold dose is required before the effect begins to be manifest. In view of

the fact that exponential curves are essentially linear at the beginning, this can be taken as evidence of an exponential relationship.

Having become convinced that mutations can be produced by x-rays, geneticists were quick to grasp the significance of the proportional relationship. The hereditary material of the germ cells exists as definite but ultramicroscopic particles, called *genes*. It is now known that these are specific chemical entities in fixed order lying along the chromosomal fibers like beads on a string. It is known, further, that mutations are produced when the position of the genes with respect to their linear relation to each other is changed (translocation, inversion, deletion) and when the organization of the gene itself is modified (gene mutation). It would thus seem that the radiation quanta act directly on the chromosomes as targets to cause breakage of the fibers or changes in the chemical make-up of the gene itself.

In an attempt to obtain direct proof of this thesis a number of experiments have been carried out. First, an answer was sought as to whether the action of the radiation is directly on the chromosome or indirectly by way of initial changes produced in the cytoplasm or elsewhere. The earlier findings opposed the idea of indirect action, since the mutations could be produced by irradiating sperm and since sperm contain mostly chromosomal material. Ingenious experiments, however, reported by Muller in 1930, Timofeeff-Ressovsky in 1931, and Wilhelmy, Timofeeff-Ressovsky and Zimmer in 1936, in which cells with a particular chromosome were irradiated and tested on the one hand, and cells without such a chromosome were irradiated and tested on the other, showed without question that the injury produced in the chromosomes by radiation is a direct one.

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[2] Muller, 1939, has pointed out that the shape of this curve is not strictly linear and that the production of mutations in the form of chromosome breaks that are wide apart more nearly varies as the 3/2 power of the dose of radiation applied.

A number of experiments were carried out to determine whether the relationship between dose of radiation and number of mutations produced could be modified. Muller, 1930, investigated the influence of the metabolic rate on the production of mutations with radiation by feeding and starving experiments and found no effect. Timofeeff-Ressovsky, 1931, showed that radiation applied at a given time has no influence on the frequency of mutations produced by treatments applied at a subsequent time; this indicates an all-or-none event, since no residual effects appear to be carried over from the first treatment to the second. The same author has shown that equal doses of radiation delivered in fifteen minutes or over a period of several days produce the same number and kind of mutations, thus demonstrating the absence of partial effects or recovery. The production of mutations with radiation has also been found to be independent of temperature during treatment, by Stadler, 1928, who varied it from 10 to 50° C., by Muller, 1930, who varied it from 8 to 34° C., and by Timofeeff-Ressovsky, 1934, who varied it from 10 to 35° C. Since the reaction velocities of practically all known chemical processes have an appreciable temperature coefficient, and since the effectiveness of a photo product may become lost or dissipated when the chemical activity is slowed, it has been suggested that this finding tends to rule out the possibility of significant secondary effects of the radiation.

While the above experiments were conducted by means of well established breeding methods, others were carried out by means of cytological procedures to ascertain whether visible morphological evidence could be obtained to show chromosome alterations. The very fortunate discovery of the giant character of the salivary chromosomes in *Drosophila* by Painter, 1934, made this possible. Preparations of these have revealed translocations, inversions, and deletions which could be directly correlated with mutations produced by x-rays and detected by breeding experiments (see Muller, 1930, 1934, 1938, and Timofeeff-Ressovsky, 1931, 1934, for careful and extensive reviews of this work). This furnishes incontrovertible evidence that radiation produces localized effects along the chromosomes.

While rather extensive evidence has been accumulated favoring the idea of discrete action, it is not to be presumed that evidence to the contrary has not been obtained. Muller, 1930, points out that internal conditions, such as age and stage of the parent organisms, tend to influence the frequency of mutation, which would not be expected if the radiations were acting in a specific manner on discrete entities; further, he indicates that simple mutations occur rather more often than would otherwise be expected. Gulbenkian, 1934, presented information to the effect that the germ cells may be affected indirectly by applying the radiation to the soma cells. This latter point was not substantiated in similar experiments carried out by Kerkis, 1935, and by Wilhelmy *et al.*, 1936. In regard to the objections raised by Muller, it may be said that no further work of a similar nature has been published, which leads to the presumption that they have not been found significant. It would seem, therefore, that the main body of evidence derived from radiogenetic studies tends to favor the all-or-none target action of radiation.[3]

Nature of the Hit.—What constitutes a hit has not thus far been discussed. Three central ideas have been advanced. The first of these was presented in 1924 by Crowther, who suggested that *a hit is effected by the production of an ion pair* within

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[3] Parenthetically, if radiation acts on germ cells to cause mutations, it ought to act on soma cells in the same way. Somatic mutations have, in fact, been produced by Patterson, 1939, with radiation, which thus renders the postulation and observations consistent. In this connection it is of interest that the existence of certain neoplastic growths in *Drosophila* has been demonstrated to depend upon genes (Stark, 1918-1937). So far as we know, however, no such mutations have been observed to result from treatment with x-rays.

the sensitive zone.   The second was pre-sented in 1927 by Condon and Terrill and further elaborated in 1929 by Holweck and Lacassagne, who attributed the *hit to the action of photons* in the sensitive part. The third was presented by Glocker, 1932, and later by Mayneord, 1934, and pre-sumes that *a hit is registered when electrons pass through some sensitive target area.*   In order to decide among these three hy-potheses, the most satisfactory approach is the comparison of the injury curves obtained with different wave lengths of radiation.

Taking the photon theory first (the second of those mentioned above), it may be pointed out that, since the number of quanta for any given amount of energy varies directly with the wave length, the biological injury would be expected to have a wave length dependence.   Since, however, no such relation has been firmly established, the photon theory is rendered doubtful by this fact alone.

In regard to the hit consisting of an electron passage, it may be pointed out that the length of the electron path and the specific ionization density along the path are critical factors to be considered and that, since these vary with wave length, both the shape of the injury curves and their positions would also be expected to vary with wave length.   The applicability of this hypothesis seems untenable in view of the fact that the shapes of injury curves, in the main, have been found to be inde-pendent of wave length, and that the ef-fects are more closely related to the total amount of absorbed energy than to the number of quanta.

There remains the possibility that the hit consists in the production of an ion pair, in which case the shape of the injury curve should be independent of wave length and the effect closely related to the ionization.   While the experimental evi-dence thus far available tends to be more in agreement with the ion pair hypothesis, the whole subject of the nature of a hit is in an unsettled state and does not permit final conclusions at this time.   For a

critical discussion of the physical aspects of these concepts, the reader is referred to the papers cited and to the following: Crowther, 1938; Lea, Haines, and Coul-son, 1936; Timofeeff-Ressovsky and Zim-mer, 1935;   and Goodspeed and Uber, 1939.

Summary.—It is apparent from that which has thus far been stated that the question of how radiation affects cells is resolved into one of whether specific action or general action is the more im-portant.   In the case of radiogenetic changes, it seems clear that specific action prevails.   In the case of other radiobiologic changes, however, it is not so obvious just which type of action is in effect in each case.   For the latter, both sigmoid and exponential types of curves have been obtained, the majority being of the sig-moid type.   Usually, however, these have been obtained with multicellular organisms and by observing effects not well suited for quantitative measurement, thus render-ing proper analysis difficult or impossible. The exponential curves for the genetic changes and for complete killing in single cells are based on clear cut measurable effects and permit quite definite deduc-tions.   Since only a few curves for com-plete killing in single-celled forms have been described, it is of interest to investi-gate further the action of radiation on these and other forms in order to ascertain whether in some cases a different type of response may be found.

As a step in this direction we have carried out a study on this same form of *Achromobacter fischeri.*

PART II: EXPERIMENTAL

Characteristics of Test Material.—*Achro-mobacter fischeri*, a motile, free-swimming sea vibrio (Johnson and Shunk, 1936), was selected for experimental use because it offers certain definite advantages over other organisms for this type of investiga-tion: (1) The organisms are not clumped together and therefore present none of the difficulties arising from multicellular forms such as staphylococci, which form grape-

like clusters, or streptococci, which form long chains. (2) They can be cultured with ease, both on solid and in liquid media, and have simple nutritional requirements. (3) They have the supplementary characteristic of bioluminescence, which makes them of particular interest and offers an additional means of detecting living activity.[4] (4) The organisms have the faculty of rapid propagation, so that experiments may be completed quickly. (5) The growth of the organisms can be inhibited at will by depriving them of their
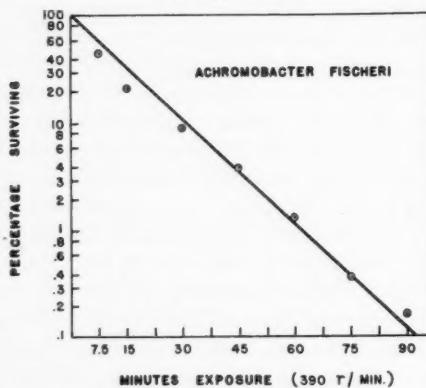

Fig. 2. Semi-logarithmic plot showing the percentage of bacteria surviving as a function of exposure to 200-kv. x-rays

simple and single nutritional requirement—peptone.

The artificial buffered sea-water medium of Hill, 1928, without glycerol was employed as the non-nutritive medium to inhibit growth. This medium is a mixture of 22 gm. NaCl, 3.5 gm. $MgSO_4$, 2.5 gm. $MgCl_2$, 0.7 gm. KCl, and 0.1 gm. $NaHCO_3$, dissolved in 1000 ml. of tap water. It was prepared fresh for each experiment and sterilized in the autoclave fifteen minutes at 15 lb. pressure. That this non-nutritive sea water brings the growth of the cultures practically to a standstill is demonstrated by the observation that 2-ml. portions of a very dilute non-nutritive sea-water suspension of the bacteria prepared before and after an experiment was completed did not reveal

[4] The effect of radiation upon bioluminescence will not be considered in the present communication.

any appreciable difference in the number of colonies counted upon separate test plates.

The best nutrient liquid medium for sustaining growth of the bacteria was prepared by adding 5 gm. of peptone to 1000 ml. of the artificial sea water. This never failed to produce active and rapid growth of the organism. The solid nutrient medium employed in our experiments was prepared by adding 25 gm. of Bacto Nutrient agar and 2 gm. of peptone to 1000 ml. of the artificial sea water. The hydrogen ion concentration of both media was maintained at 7.6 to 7.8 for best results. By employing such culture media we always obtained a satisfactory yield of the organisms with constant physiological responses mainly characterized by bright luminescence and rapid rate of propagation. At intervals the cultures were investigated for possible contamination by air-borne spores and other micro-organisms.

Preparation of Suspensions for Treatment.—In order to obtain suitable concentrations for the experiments, it was necessary to reduce the enormous number of bacteria present in a twenty-four-hour culture to a number that could be conveniently dealt with subsequently. The following routine was therefore adhered to in preparing the bacterial suspensions. With a sterile pipette of 2 ml. capacity, 0.2 ml. of the twenty-four-hour culture was placed in a mixing bottle containing 200 ml. of non-nutrient artificial sea water and vigorously shaken. The initial dilution of the organisms was thus 1:1000. Of this suspension 2 ml. were then placed in a series of sterile round celluloid boxes, in which the suspension had a depth of 3 mm.

Experimental Procedure.—The x-ray tube used was a water-cooled, heavy glass Coolidge type which was maintained at 200 kv. and 30 ma., without filter. The distance from the target to test material was 34 cm. and the output was 390 r/min. as measured by a thimble type ionization chamber. The cultures were exposed 7½, 15, 30, 45, 60, 75, and 90 minutes, which

TABLE II.—RESULTS OF IRRADIATION OF ACHROMOBACTER FISCHERI

Colony Plate Counts

Minutes Exposure	0	7.5	15	30	45	60	75	90
Exp. No.								
1	4,460	1,940	1,290	410	130	91	13	7
2	17,680	8,640	1,840	920	640	186	66	43
3	11,940	4,720	2,230	990	346	167	49	28
4	9,470	4,360	2,070	740	. . .	74	17	9
5	9,720	3,980	1,960	980	570	190	57	33
6	2,960	1,430	920	207	67	17	0	0
7	12,780	5,220	1,870	490	234	110	50	12
8	3,370	1,420	850	390	170	35	8	0
9	9,740	3,830	1,720	1,010	540	220	63	27
10	5,620	2,170	1,340	510	260	110	32	8
11	9,320	3,740	1,830	910	470	180	40	23

Percentages

	0	7.5	15	30	45	60	75	90
1	100	43.5	28.9	9.18	2.91	2.02	0.29	0.16
2	100	48.8	10.4	5.21	3.62	1.05	0.37	0.24
3	100	39.5	18.6	8.30	2.90	1.40	0.41	0.23
4	100	46.0	21.8	7.81	. . . .	0.78	0.18	0.10
5	100	40.9	20.1	10.10	5.86	1.95	0.59	0.34
6	100	48.3	31.1	7.00	2.26	0.57	0.00	0.00
7	100	40.8	14.7	3.84	1.83	0.86	0.39	0.09
8	100	42.1	25.2	11.60	5.04	1.04	0.24	0.00
9	100	39.4	17.7	10.40	5.55	2.26	0.65	0.28
10	100	38.6	23.8	9.08	4.63	1.96	0.57	0.14
11	100	40.1	19.6	9.76	5.04	1.93	0.43	0.25
Av.	100	42.5	21.0	8.38	3.96	1.43	0.37	0.17
		±0.631	±1.21	±0.457	±0.344	±0.12	±0.0385	±0.0225

is equivalent to 2,925, 5,850, 11,700, 17,550, 23,400, 29,250, and 35,100 r. An unirradiated control was treated in all respects like the irradiated series. After the completion of the experiments, 1-ml. portions of the samples were transferred each to a mixing bottle containing 200 ml. of non-nutrient sterile artificial sea water. To avoid the possibility of any bacterial clusters being present at this stage of the experiment, the contents of the bottles were vigorously shaken.

For the purpose of determining the number of surviving organisms, the usual plate-counting method was adapted to the needs of the present investigation. By using only young twenty-four-hour cultures we were reasonably assured of a certain constancy in the experimental results. The final transfer for the purpose of plating was made in 1 ml. portions each to 15 c.c. of nutrient sea-water agar, previously melted and cooled to 40° C. The warm agar mixture of the suspended organisms was carefully poured into 75-mm. Petri dishes. After cooling, the

plates were inverted and incubated for forty-eight hours at 26 ± 1° C. The number of colonies upon the plates was counted by means of a counting chamber of standard type and the survival ratios were determined.

Results.—The tabulated results showing the number of the surviving organisms as well as their survival percentages are presented in Table II. The survival percentages are averages of many counts, 8,824 being the average number of control colonies for each separate experiment. Such large numbers of organisms at the beginning are essential if an appreciable number of colonies is to be observed in those samples receiving large doses of radiation.

The average survival percentages were placed on a semi-logarithmic scale (Fig. 2), where they fit a rectilinear type of curve with impressive regularity. That the curve is exponential in character is clearly demonstrated by its clean-cut appearance, together with the constancy of the experimental values in Table II. This, therefore, places the response of *Achro-*

mobacter fischeri to x-rays in the single-hit-to-kill category discussed at length in Part I of this paper.

SUMMARY

1. A short historical review has been presented of the prevailing ideas and experimental studies on the biological action of radiation.

2. Experiments are recorded in which the survival curve for *Achromobacter fischeri* after treatment with 200-kv. x-rays was found to be of the exponential type.

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THE SILICOSIS PROBLEM[1]

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SILICOSIS has for many years been a burning problem, especially in countries in which mining is among the most important industries. In many places pioneer work of great importance has been done with a view to combating the disease. In others, it has taken longer before the importance of such work has become recognized; especially there has been no clear conception of the fact that silicosis is far more prevalent in other dust-producing industries than in mining, and in a great many more than imagined.

Of course, the composition of the dust plays a rôle both as regards the development of the silicosis and the type of roentgen film it produces, even though the latter is in the main the same in those engaged in the same occupation. But the type of the silicosis depends also in a great measure on the quantity of dust inhaled by the individual, and thus on the speed with which the silicosis develops. Therefore, the conditions under which the work is performed play a very great rôle as regards the appearance and development of the type of silicosis. In consequence, we cannot compare the type and the degree of development of silicosis in a given industry in one country with what is found in another; and when one begins a thorough investigation of the silicosis in a certain place it is, therefore, necessary to build up one's own experience in regard to the type and degree of silicosis in the occupations concerning which there is question in that place.

As an example of this I may mention that while the risk of silicosis for granite quarriers in America and England is reckoned as very serious, and the type encountered there is a rapidly developing, dif-

fuse interstitial one, the disease has occurred only sparsely among the granite quarriers on the island of Bornholm, Denmark, and has there been of a peribronchial-perivascular type—in other words, of slow development. It is probably the conditions under which the work is performed which play a rôle here; and, in fact, the granite workers in Bornholm work mostly in the open air.

It is the same with the complications. Of these, we know that tuberculosis is, all over the world, stated to be by far the most prevalent and the most serious. It is my absolute impression, however, that this risk of tuberculosis is much exaggerated. This is not yet to be seen clearly in the literature, but there is no doubt that, in time, it will prove to be correct. Of course, the environment and the possibilities for infection play a great rôle; but when the mortality from tuberculosis in certain places is stated to be excessively great, it may possibly be because comparison has been made with selected cases and not with all the workers.

In Denmark, investigations in regard to silicosis have not shown that there is any especial tendency to complication with tuberculosis, nor to the development of particularly severe tuberculosis. Of course, a silicotic lung is less capable of resistance than a sound one, and it is, therefore, most important that the risk of infection should be guarded against by all available means; but that silicosis in general should offer a particularly good soil for tuberculosis, I simply do not believe. The experimental researches that have been made into that subject carry no weight whatever.

It is impossible to deny, however, that certain forms of silicosis are more susceptible than others, and this is especially true of the rapidly progressive forms.

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[1] Read before the Fifth International Congress of Radiology, at Chicago, in September, 1937.
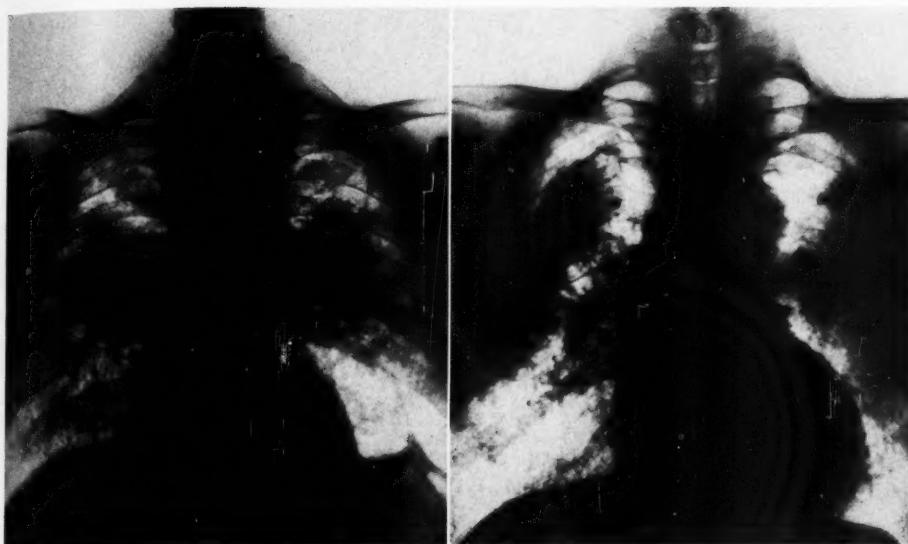
Figs. 1 and 2.   Lung changes due to silicosis.   See text.

It is well known that many silicosis patients are declared to have tuberculosis, especially on the basis of a roentgen examination.   Many are sent to sanatoria, where they are accepted under the assumption that it is a question of an old healed tuberculosis.

That so many cases of silicosis are mistaken for old tuberculosis is partly because radiologists are not fully familiar with the various forms which silicosis may assume; partly because many of them do not know that the changes which mark silicosis in the third stage may have exactly the same appearance as that found in a case of severe old tuberculosis.   In fact, some authors maintain that such massive silicosis is always complicated by tuberculosis.

In my opinion this is absolutely not so. The lung changes shown in Figure 1 are without doubt due entirely to silicosis. Clinically, there was nothing that would indicate that this man had, or had had, tuberculosis.   Of course, the question becomes more difficult to settle when the changes become more diffuse, as in Figure 2. Clinically, there was nothing that pointed to a fresh infection of tuberculosis.

This patient has since died of pneumonia, and the autopsy did not show any fresh infection of tuberculosis.   To a certain extent this film, with the many calcifications, also shows that a silicotic lung cannot really be said to be particularly favorable soil for the development of severe tuberculosis.

If, in a silicotic lung, we find fresh tuberculosis, fairly isolated from the silicotic processes, it is not difficult to distinguish the tuberculous changes from the silicotic; but if they blend with each other it may be impossible to make a diagnosis from the roentgenologic film alone.   The history and the clinical features must be considered, too, in order to reach a conclusion.

I have never seen cavities in roentgenograms of cases of uncomplicated silicosis, but I have sometimes seen them at the postmortem table.   Another thing, the development of a localized emphysematous area, with large emphysema bubbles, may possibly simulate a tuberculous cavity. Emphysema in a silicotic lung is frequent, and is one of the chief complications in the severe cases.   When one has seen such emphysema inflations at the postmortem

Fig. 3 Spontaneous pneumothorax and emphysema complicating silicosis.

Fig. 4 Post-mortem specimen from case shown antemortem in Fig. 3.

table, one does not wonder that spontaneous pneumothorax is a not infrequent complication of silicosis (Figs. 3 and 4). Curiously enough, there is little mention of this in the literature.

It is not every form of silicosis, however, that results in emphysema and the formation of emphysema bubbles. In cases in which the silicosis develops rapidly, I do not believe there is any chance for the development either of particularly pronounced emphysema or of emphysema bubbles; but in cases in which the silicosis progresses slowly, so that there can be time for shrinking, there is a probability that localized areas of emphysema may develop within the fibrotic tissue, and that these at some time or other may burst and produce a pneumothorax, endangering the patient's life.

I have also seen spontaneous pneumothorax, however, in cases in which silicosis was only slightly developed.

Another danger which threatens the silicotic is the cardiac hypertrophy which often accompanies the more severe cases, and the resulting degeneration of the heart.

Spontaneous pneumothorax and paralysis of the heart are the two dangers which at any time may threaten the silicotic subject with sudden death. Yet the greatest general risk for these workers lies partly in their tendency to affections of the air passages, partly in the circumstance that any affection of the air passages, whatever its nature, must entail a serious risk for the individual, because so large a part of the lung tissue capable of functioning has become lost.

From various clinical sides voices have been raised against attaching too great importance to the silicotic changes found in roentgen films on mass examination of industrial workers. "But those people are well," it has been said. It is true that the roentgenologic findings are often in sharp contrast to the general well-being and working capacity of the individual, and we should not, therefore, frighten the workers by taking their condition too seriously.

But when one reviews one's experience of silicosis through years of investigation, one finds that under certain circumstances the

silicotic condition makes the individual less resistant, and that if it is allowed to develop it ends by sending its victim to an early grave as the result of a complicating affection of the air passages.

In Gudjonsson's statistical work, from 1932, on silicosis among the porcelain workers in Denmark, one-half of the diseases stated as cause of death were affections of the air passages.

In my own study, from the same year, covering the same 798 porcelain workers, there were 18 cases of third degree silicosis. By now—that is, five years later— eight among this number are dead, seven of them from affections of the air passages.

Silicosis is a social danger and a social problem which the health authorities in most places have been much too late in recognizing, but against which it is of great importance that a fight should be made. If the problem is taken up, various measures must be introduced, and among these I will mention the important one of efficient medical control of the workers.

As silicosis can be diagnosed only by roentgen examination, it is of extreme importance that all roentgenologists should be entirely familiar with the different forms and types which silicosis may assume, to enable them to make the diagnosis with sufficient certainty. But it is also necessary to realize that though experience shows that rational prophylactic measures reduce the risk of silicosis, there are many industries in which that risk probably cannot be entirely eliminated, and that pneumoconiosis is consequently a more or less unavoidable hazard in these particular industries.

RECOVERY OF CARBON MONOXIDE POISONED MONKEYS UNDER X-RAY TREATMENT[1,2]

By JOHN A. CAMERON, A.M., Ph.D., Department of Zoology, University of Missouri, *Columbia, Missouri*

AN account of the differential recovery of carbon monoxide poisoned rats when exposed to x-rays has recently been published.[3] It was based on the idea that, since illumination with strong visible light removes carbon monoxide inhibition in fish embryos (Fisher and Cameron[4]), the stronger radiations of x-ray might promote the recovery of larger, more opaque animals. The following report extends this work to the primates; selected, newly imported *Macacus rhesus* monkeys weighing from five to six pounds were used.[5]

· Pure CO was prepared and stored as described by Fisher and Cameron. The atmosphere of the gas chamber was adjusted to contain 12.5 per cent CO by volume in air. In five experiments the test animal and the control were left in the 12.5 per cent CO for the same length of time and were removed simultaneously from the gas.

The animals were placed in identical wooden boxes with wire-screened tops, and the test animal placed under the tube of a Victor x-ray machine (Snook model), operated at 140 kv.p.; tube current 4 ma.; target distance 10 in.; delivering 130 r per min. This machine and its operator were loaned by L. J. Stadler, Ph.D., whose advice and assistance are gratefully acknowledged. The head of each x-rayed monkey was protected by lead during exposure.

Nine experiments were begun, of which the seven giving positive results are reported below. In the other two, both monkeys were over-gassed and died in the gas chamber before x-ray could be applied.

In three of the seven experiments, the control animal had died by the time the test animal was removed from the x-ray compartment after an exposure of from five to six minutes. Each of the three surviving test animals was active and vocal, making determined efforts to escape from the exposure box at the time it was removed from under the tube. In these cases the x-rayed animals were restored and those not x-rayed died, all other conditions of the experiment being equal.

In the other four experiments, sub-lethal exposures to CO were made and the same animal served once as a test animal and once as a control, with an interval of one week or more between the two parts of the experiment. This interval permitted observation to assure complete recovery from one exposure before the next was made. Yandell Henderson[6] and Nicloux[7] are agreed that no detectable CO remains in the blood of primates four hours after the end of the period of exposure to CO, so this is a wide margin of safety. In these cases the time required to reach various stages of recovery and to resume normal activity was reduced to one-half or one-third that required when x-rays were employed. It seemed to make no difference whether the x-ray test exposure preceded or followed the spontaneous recovery exposure.

PROTOCOLS

1. Nov. 8, 1939. Eight and a half minutes in 12.5 per cent CO. The test animal was up and active after five-minute exposure to x-ray (650 r).

Nov. 17, 1939. Eight and a half minutes in 12.5 per cent CO. The same animal, when given no x-ray, regained control of eye muscles after six minutes, turned dorsal side up after 18 minutes, rose to all-fours after 22 minutes, crawled after 29 minutes.

2. Dec. 4, 1939. Five minutes in 12.5 per cent CO. The test animal regained control of eye muscles six minutes after the beginning of a three-minute x-ray exposure, turned dorsal side up after eight minutes, rose to all-fours after 11 minutes, crawled after 14 minutes.

Nov. 27, 1939. Five minutes in 12.5 per cent CO. The same animal, when given no x-ray, regained control of eye muscles after eight minutes, turned dorsal side up after 14 minutes, rose to all-fours after 21 minutes, crawled after 27 minutes.

3. Dec. 6, 1939. Five minutes in 12.5 per cent CO. The test animal was up and fighting to get out of box after five-minute exposure to x-ray.

Nov. 29, 1939. Five minutes in 12.5 per cent CO. The same animal, when given no x-ray, regained control of eye muscles after four minutes, turned dorsal side up after six minutes, rose to all-fours after 11 minutes, crawled after 14 minutes.

4. Dec. 11, 1939. Six minutes in 12.5 per cent CO. The test animal regained control of eye muscles after five-minute exposure to x-ray, turned dorsal side up after nine minutes, rose to all-fours after 12 minutes, crawled and sat up after 15 minutes.

Dec. 18, 1939. Six minutes in 12.5 per cent CO. The same animal, when given no x-ray, regained control of eye muscles after nine minutes, turned dorsal side up after 15 minutes, rose to all-fours after 28 minutes, crawled after 36 minutes.

It is concluded that x-ray treatment in moderate amounts was a critical factor in the recovery of the seven cases reported.

CASE REPORTS

PENDANT MASTOGRAPHY[1]

By DAVID E. EHRLICH, M.D., *New York City*

From New York City Cancer Institute, Department of
Hospitals, City of New York

In 1930, S. L. Warren (1) published his
work on "A Roentgenologic Study of the
Breast," in which he outlined the rationale
and technic and presented conclusions which
have stood the test of time. In 1932, Fray and
Warren (2) pointed out that serial study is

be determined. The arm on the side of the
breast to be x-rayed is elevated, with elbow
bent, grasping a support at side of the cassette
holder. The opposite breast is lifted and held
out of the way by the patient. Then the
patient is tilted so that the breast to be x-rayed
hangs away from the body. The film is taken
in inspiration with the central ray passing
through the center of the breast, with the
axilla included in the field. The factors are:
42 in. distance, 30 ma., 50 kv., 1/10 to 1/8 sec.,
cassettes with double screen, without Bucky

Fig. 1. Positioning. Postero-anterior view.
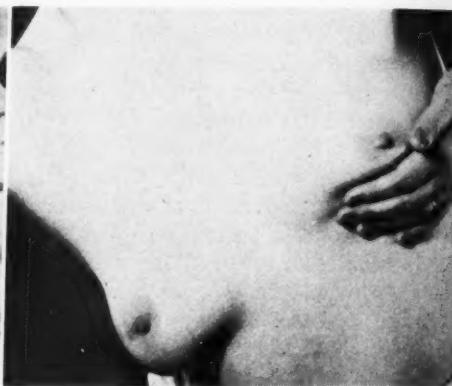
Fig. 2. Positioning. Anteroposterior view.

valuable, especially in cases in which clinical
evidence is insufficient for operation. In 1932,
Lockwood and Stewart (3) stressed the value
of roentgen examination as furnishing a perma-
nent record for serial study of mammary
changes. Seabold (4) has evaluated its rela-
tion to palpation of the breast. In 1937,
Hicken (6) introduced contrast media into the
breast, disclosing most dramatically and clearly
the breast anatomy and pathology on the
x-ray film.

It is not my intention to go over the ground
already seeded. My purpose is to introduce
the pendant position of the breast, with the
patient standing. This position is taken ad-
vantage of in making examinations of the
other parts of the body. It appears to have
eliminated positional distortion in the breast
markings which appear in the prone table
technic.

The patient stands facing (Fig. 1) the
cassette and turns so that the best angle may

grid. The opposite breast should also be
roentgenographed. In some instances better
results were obtained when the patient faced
away from the cassette (Fig. 2). A non-screen
technic was attempted but did not prove suc-
cessful, although non-screen films may prove
to be of value in the future.

Pendant mastography has now been used
in this institution since the beginning of 1937.
At first the clinicians permitted and tolerated
it; now they have become its staunch sup-
porters.

In our series of over 200 cases, there was a
close correlation of the clinical and x-ray
findings. In several instances pendant mas-
tography enabled us to change the verdict
from that of cancer to a benign status. The
following several cases illustrate some of the
points under discussion.

Case 1. A. B. (No. 17,842), aged 42, was
admitted to the New York City Cancer Insti-
tute on Dec. 30, 1938, with a history of a
lump in the left breast which was discovered
three weeks previously by the patient. Upon
physical examination, under the nipple of the
left breast a round, freely movable, and en-

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capsulated mass was palpated, which was regular in outline, about three inches in diameter. The preoperative clinical diagnosis was benign tumor. X-ray examination disclosed a large, localized, oval soft-tissue tumefaction extending from the nipple region to the base, with no mammary striations within it and only several strands inferior to it. X-ray diagnosis was benign tumor. Aspiration biopsy removed 40 c.c. of amber-colored fluid, with no cellular contents. Replacement of the fluid by air disclosed a large cystic area. X-ray examination one month later still showed a

excised locally and the pathologic report was cystic disease, with intraductal papilloma.

Case 3. E. T., aged 47, was admitted to the New York City Cancer Institute on June 13, 1933, with a history of a lump in the left breast of two years' duration. Physical examination disclosed an egg-sized mass in the outer upper quadrant of the left breast. It was soft, fluctuating, and smooth in outline. An irregular node was felt in the tail of the breast and many firm enlarged nodes in the axilla. Clinical diagnosis of a cyst with malignant degeneration was made and operation was advised.

Fig. 3.   Case 2.   Normal breast.

Fig. 4.   Case 2.   Well-defined tumor, deep to nipple, benign.

slight retention of air within the region of the cyst. Follow-up examination on March 21, 1939, disclosed no tumor in the breast area.

This case demonstrates a benign cyst.

Case 2. A. De C. (No. 17,870), aged 77, was admitted to the New York City Cancer Institute on Jan. 9, 1939, with a history of a lump in the left breast of three months' duration, which the patient thought had become slightly larger in the interval. Physical examination disclosed both breasts to be soft and pendulous. In the left breast the outer areola was retracted. A hard irregular mass, 2 cm. in diameter, movable and not tender, was palpated. An axillary node was present. Clinical diagnosis of carcinoma was made. X-ray examination (Figs. 3 and 4) disclosed a well defined tumor, deep to the nipple, which was diagnosed as a benign growth. The area was

The patient failed to return to the clinic, however, at that time. In March, 1939, the patient returned and no distinct change in the physical status of the breast was found. An x-ray examination disclosed a definite area of rarefaction in the left breast, with a zone of calcium about part of its rim and extending into the axilla where calcified nodes were found. Moreover, calcified nodes were also discovered in the right side of the neck. This proved, conclusively, the presence of tuberculous infection in the neck and breast. Unfortunately, the patient has again disappeared so that there is no pathologic confirmation of the diagnosis although it has been agreed to clinically.

Case 4. L. P., aged 49, Porto Rican, was admitted to the New York City Cancer Institute on May 11, 1938, with a history of a mass in the left breast of three years' duration and

pain of three months' duration. Physical examination disclosed a hard palpable mass in the upper outer quadrant of the left breast adherent to the deeper structures, with ulceration of the anterior surface. Adenopathy was palpated in the left axilla. A coincident four plus Wassermann was disclosed and therapy has been instituted. X-ray examination showed a diffuse replacement of mammary striations by an irregular soft-tissue tumor, the outline of which was indefinite and suggested extensive malignant neoplasia. Axillary adenopathy was visualized. Simple mastectomy was performed, with the removal of the axillary nodes, and the patient is still under treatment, receiving high voltage and antisyphilitic therapy.

Warren's conclusions, on stereoscopic roentgenography of the breast, in 1930, are worth reiterating:

1. Technic is simple.
2. Appearance conforms to anatomical structures.
3. Abnormalities conform to gross appearance.
4. Diagnosis corresponded to operation and autopsy (85–95 per cent).

In my opinion, pendant mastography fills the gap between Warren's original method and Hicken's more elaborate contrast media procedure. Various devices reported in the past by Seabold (4), Gershon-Cohen (7), and others were a step in the same direction.

In closing, I plead the cause of mastography. All the cancer propaganda of the past and present stresses early diagnosis. Periodic examinations of the breast should include mastography as a routine procedure, giving a permanent record for future serial study.

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INTUSSUSCEPTION[1,2]

PARTICULAR REFERENCE TO ROENTGEN DIAGNOSIS WITHOUT OPAQUE MEDIA

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About 25 per cent of cases of intussusception occur after the age of two years and even these are more frequent in early childhood. It is predominant in the male in the proportion of about three to one. The acute type is rarely seen in an x-ray department.

Predisposing conditions are frequently present in older children and adults. In infancy, there is usually no evident cause. According to Perrin and Lindsay (3), inflammatory changes in the lymphoid tissue of the small intestine constitute a significant factor. Intestinal spasm resulting from change in the diet at the time of weaning is said to be an etiologic agent, and a tumor of the bowel, Meckel's diverticulum, or ulcer is believed to account for about 70 per cent of cases of intussusception in adults (Christopher, 1).

The barium enema, motor meal, and examination of the abdomen without opaque media are used to diagnose intussusception. The opaque meal or barium enema is preferred by many. There is an extensive literature on the subject of roentgen diagnosis, but relatively little deals with examination without the use of opaque media. Schatzki (5) reported on the roentgen appearance of intussuscepted tumors of the colon, with and without the use of barium.

There can be no doubt that the simplest procedure which may be of diagnostic value should be used. When an acute condition is present or suspected, examination without opaque media is, therefore, preferable and is used routinely by the author. The roentgen signs of intussusception revealed by barium enema may also be present in this simpler type of examination.

If the canal of the intussusceptum contains air, it will be surrounded by the walls of the intussusceptum and the intervening mesentery. Air in the intussuscipiens or ensheathing layer will partially, or apparently completely, surround the latter. In the absence of air in the canal of the invaginated portion, a homogeneous sausage-shaped shadow surrounded by a narrow radiolucent area may be seen. The

latter may consist of a single layer or of multiple layers of air. The haustra of the bowel in the region of the mass may be distended. The defect may change in shape, position, and apparently in degree, in the recumbent and upright positions and in subsequent examinations. A mass is usually palpable in the region of the intraluminal defect. If stenosis ensues, the proximal bowel becomes distended and signs of intestinal obstruction are demonstrated. Free air in the peritoneal cavity is indicative of a complicating perforation. The accepted

history of blood in the stools or vomitus. He was seen about 20 hours after the onset of the illness and complained of mild mid-abdominal pain.

Physical examination revealed a soft mass in the right lower abdominal quadrant and deep tenderness over this area. The abdomen was soft, distended, and tympanitic. The temperature was 99° F. and the pulse and respiratory rate per minute were 66 and 20, respectively. The essential laboratory finding was a total leukocyte count of 27,500 per cubic milli-
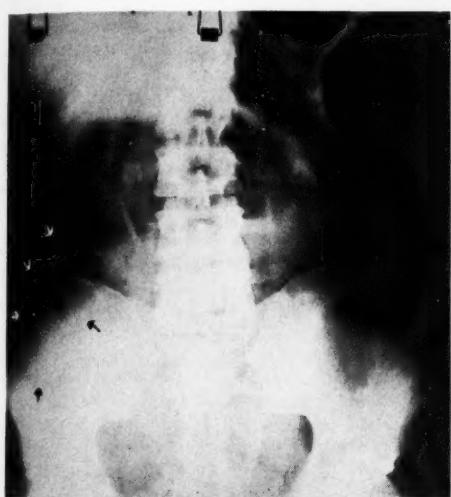
Fig. 1.   Fig. 2.

Fig. 1. Shows the intussuscepted portion of intestine (A) surrounded by air in the ensheathing layer (arrows).
Fig. 2. Demonstrates the mass (A) and air in the ensheathing layer (arrows) and fluid levels. The multiple radiolucent areas (double arrows) represent air in folds of bowel in the region of the invagination.

roentgen criteria are not always present and neither are all of them pathognomonic of intussusception. This is to be expected, because the signs are a graphic manifestation of the underlying pathologic changes. The presence or absence of air in the involved loop of intestine, extent of edema, congestion, presence of adhesions, necrosis, or of an exciting factor determine the roentgen signs. It is, consequently, of utmost importance to integrate carefully the clinical and roentgen evidence (Rendich and Abrams, 4). The following report is that of a case recently encountered.

The patient was a white male, 44 years of age. While at work, he had a sudden acute attack of excruciating generalized abdominal pain. This was soon followed by a copious bowel movement, but the pain persisted. He vomited several times, but there was no

meter, of which 84 per cent were polymorphonuclears and 12 per cent were lymphocytes.

Roentgen examination of the abdomen in the recumbent position, without opaque media (Fig. 1), revealed a fairly homogeneous sausage-shaped soft-tissue shadow surrounded by air. This extended from the level of the right iliac fossa almost to the hepatic flexure. The essential findings with the patient erect (Fig. 2) revealed fluid levels in the hepatic flexure region, transverse and descending colon. Several small linear gas collections and a similar curved area with convexity upward were noted just above the level of the right iliac crest. These findings were believed to be due to intussusception of the terminal ileum. The fluid levels were thought to represent residuals of an enema. Inquiry revealed that an enema was administered shortly before the x-ray ex-

amination and that a dark brown liquid stool was returned. A subsequent bedside examination (Fig. 3) showed a change in the intestinal pattern, apparent alteration in the shape of the soft-tissue mass and in the arrangement and configuration of the air surrounding it.

Operation revealed a large area of markedly inflamed and gangrenous small intestine, which extended to about six inches proximal to the ileocecal valve. The ileum was invaginated into itself just below the level of the ileocecal valve and extended into the cecum and ascending colon nearly to the hepatic flexure. The intussusception was reduced.

Fig. 3. Roentgenogram made at bedside shows alteration in the shape of the mass (A) and in the arrangement and configuration of the surrounding air (arrows).

The bowel was resected and a side-to-side anastomosis was made about four inches above the level of the ileocecal valve. Recovery followed a stormy post-operative course.

The tissue removed at operation consisted of 15.5 in. of distal ileum. The middle portion, approximately 3.75 in., was moderately constricted. The remaining portion was moderately dilated. The mucous and submucous coats of the constricted portion showed severe inflammation and edema and consequently the lumen was markedly narrowed. There was no evidence of tuberculosis, polypoid tumor, or growth of any nature. Sections from the constricted portion showed marked leukocytic infiltration, numerous hemorrhagic areas, capillary stasis, edematous and necrotic changes. The serous and mesenteric attachments revealed similar changes,

as did sections from proximal and distal portions of the specimen to a less extent. There were no cells or structural changes to suggest tuberculosis, adenomatous or malignant elements.

Several aspects of this case make it noteworthy. The intussusception occurred in an adult and apparently constituted a so-called acute primary type. A history of a previous similar attack was not obtained. Acute intussusception rarely recurs and in the reported recurrences the cause was usually a small tumor within the bowel. No exciting factor was found in this case at operation or in the tissue removed. The diagnosis was made by roentgen examination of the abdomen without the use of opaque media. The patient recovered. The mortality is said to be from 3 to 20 per cent (Christopher, 1). The risk is, of course, great in late cases requiring resection.

CONCLUSIONS

Intussusception is briefly discussed.

Roentgenographic diagnosis without the use of opaque media is considered.

A case of acute intussusception, primary in the ileum with secondary invagination into the cecum and ascending colon, is presented.

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EXTENSIVE DESTRUCTION OF LUNGS[1]

EMPHYSEMA WITH GIANT BULLÆ—AUTOPSY

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The case described below represents so extreme a degree of destruction of pulmonary tissue as to be of special interest.

Case History.—D. H., male, aged 41 years, consulted the author in February, 1939, complaining of cough, dyspnea, and asthmatic

wheezing of eight years' duration which had become progressively worse for the past three years, with marked exacerbations and partial remissions. The cough had been productive of greenish-yellow sputum which, at times, had had a fetid taste and odor. Recently the sputum had been white. Since the summer of 1938, wheezing and dyspnea had been constant. The patient had lost 27 pounds since the onset of the illness. He had worked at various forms of labor—farm hand, general laborer, and house painter—until 1931.

The past history elicited the story that he had coughed since childhood, that he had had "stomach ulcers" in 1929, and gonorrhea, complicated by stricture, in 1932. The family history was irrelevant.

Physical examination was negative except for chest findings. The patient was undernourished and breathed with obvious effort, the chest wall moving only slightly. There was hypertrophy of the accessory muscles of respiration. The chest was barrel-shaped. There was tympany over both sides with distant (almost absent) breath sounds over the entire right chest except along the base anteriorly, where distant sounds and expiratory rhonchi were heard. On the left, breath sounds were almost absent at the apex, gradually increasing in intensity to the region of the eighth rib posteriorly and the third rib anteriorly. There were scattered sibilant râles below the third rib anteriorly. These findings were practically identical with those of Richard Nauen, M.D., of the New York State Hospital for Incipient Tuberculosis, who had examined the patient in October, 1938.

Roentgenograms showed complete absence of lung markings in the upper half of the right lung and upper third of the left lung, with herniation of the mediastinum to the left. There had been no noticeable change since the previous roentgenograms made four months before.

Repeated examinations of sputum were negative for tubercle bacilli. The Wassermann test and other routine laboratory studies were negative.

A diagnosis of chronic bronchitis, asthma, and pulmonary emphysema with giant bullæ had previously been made by Dr. Nauen. Further observation threw no additional light on the subject. The examining roentgenologist, H. L. Sampson, considered that the process should be termed congenital cystic lung involvement.

In an attempt to determine any allergic factor which might be contributing to the patient's discomfort, he was studied at another institution by Dr. Harold Medivetsky. Death occurred in July, 1939, but autopsy was so long delayed as to render bacteriologic study inconclusive, except to indicate the likelihood that death was due to Type XVI pneumococcus pneumonia. The left lung was sent to the author intact and was then studied at the Division of Laboratories and Research of the New York State Department of Health, through the co-operation of Ruth Gilbert, M.D.

Composite Significant Findings.—Pleural Cavities: The right lung was found to be collapsed but a large bleb on the upper left lobe herniated through the opening in the chest wall. The left lung was adherent at the apex and the right lung posteriorly at the level of the third rib.
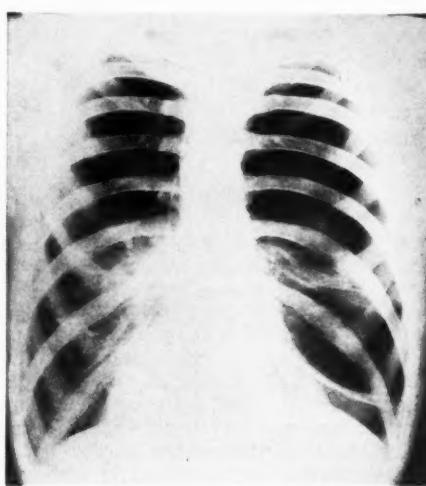

Fig. 1.   Roentgenogram of chest.

The right lung weighed 400 grams. A few emphysematous blebs were present at its apex and base. A large bleb, about 6 × 4 cm., attached to the anterior surface of the right upper lobe, had been ruptured. The wall of the bleb was thin and shiny. No connection with the bronchi was demonstrated. The remainder of the right lung had a feathery, doughy feeling. On section the lung was practically bloodless, dry, and inelastic. The left lung weighed 500 grams. There was a large, biloculated bleb 20 × 18 × 14 cm. covering the inner two-thirds of the anterior surface of the left upper lobe and involving the entire apex. The wall was thin and taut, grayish-white in color and translucent. No fluid was contained in the bleb. Within an hour the bleb became slightly deflated and the wall had a parchment-like feeling. The lower lobe had

several smaller blebs over the anterior and diaphragmatic surface. Both bronchi contained a thick, yellow, purulent material. The mucosa was markedly reddened and peribronchial tissues felt indurated. The hilar glands were firm, red-gray, and adherent to the bronchi.

The anatomic diagnosis was as follows:
1. Air cyst of the lung.
2. Pulmonary emphysema.
3. Anthracosis.
4. Purulent bronchitis.
5. Bronchopneumonia.

laries contained a few red cells (heart-failure cells). The bronchi were partly filled with red cells, polymorphonuclear leukocytes, and pigment-bearing macrophages, the walls infiltrated by polymorphonuclear leukocytes. A few of the alveoli surrounding the bronchi were filled with the same cellular elements as the bronchi, with some fibrin, giving the appearance of the onset of pneumonia. The walls of the emphysematous blebs showed fibrous tissue, with some lymphocytic infiltration on the pleural surface. Sections from or near the parenchyma showed on one side a low

Figs. 2 and 3.   Biloculated bleb on surface of left lung.

Significant Microscopic Findings.—A lymph node near the bronchus showed loss of general structure, the capsule being pigmented and infiltrated with lymphocytes, polymorphonuclear leukocytes, and an occasional monocyte; the trabeculæ were not distinct. The germinal centers were rather loosely packed with cells. Dark pigment, within and without pigment-bearing macrophages, appeared throughout.

The pleura was thickened without signs of inflammation. There were areas of atelectasis throughout and other areas of over-distention of the alveoli. The alveolar walls were somewhat thickened by fibrous tissue. The capil-

cuboidal or endothelial-like epithelium and on the other side a low cuboidal epithelium with a tendency toward low columnar epithelial structure. In places the epithelium was thrown into folds, giving the appearance of widely dilated bronchioles. The wall between the epithelial linings was composed of fibrous tissues, not highly vascular.

The microscopic diagnosis was as follows:

1. Atelectasis.
2. Emphysema with emphysematous blebs or bullæ.
3. Bronchitis with early pneumonia.
4. Anthracosis.

EDITORIAL

HOWARD P. DOUB, M.D., *Editor*   JOHN D. CAMP, M.D., *Associate Editor*

PRESIDENTIAL ADDRESS

THE PHYSICIAN, FRIEND, AND HUMANITARIAN

In speaking to you as President of the Radiological Society there are any number of subjects pertaining to radiation that might have been appropriate for discussion. I might have wandered down some fascinating bypath of radiologic history, or offered some sage comments about the training of radiologists, or expounded the significance of recent scientific advances, or the contributions of radiation to defense. It seems to me, however, that other sessions of this meeting have offered an amplitude of these things of the mind, and so I choose rather to speak to you from the heart.

We physicians and specialists have a great tendency to become absorbed in our own problems and interests, and to insulate ourselves from the happenings in the world around us. But now our peaceful calm is constantly being disturbed by the ever louder rumblings and cracklings of a world crumbling to ruin. We cannot possibly ignore these happenings, and they make us uneasy and uncomfortable:

The other day I ran across a little verse by Norman Jaffray which states somewhat facetiously what most of us are feeling:

"History's nice for an evening's reading;
All of it happened so long ago;
The logical acts from their causes leading
So clearly presented as thus-and-so!
But history happening here and now
Is a jumble of questions, ifs, perhaps;
And the worst of it's waiting to see just how
It goes off in our laps!
History to read is swell, breath-taking;
But I want to be elsewhere while it's making."

But alas, however much we should like to be elsewhere while history is making, we cannot escape it, for here we are, face to face with the shattering events of to-day and to-morrow, despite which, or perhaps because of which, we shall make our individual and collective contributions to science and the easement of human suffering.

These horrors we are witnessing are nothing new. They are of a piece with the brutality and inhumanity man has exhibited to his fellow creatures since time began. But, along with the vicious and the cruel and the ignorant, there were always humanitarians, physicians, philosophers, and poets to doubt and despair, and yet to hope, in the presence of gross atrocities and world crises. There must have been among the Druids some agnostic to doubt the piety of burning alive their human sacrifices. Some there must have been among the ancient Aztecs who could not witness with equanimity the tearing out of the pulsating hearts of the healthy young males who were sacrificed to their gods. The burning of witches, we know, evoked so much opposition that eventually it had to be abandoned.

Man has always been half god, half beast. No people and no nation is guiltless of cruelty to its creatures. Even we Americans must admit to our own shame of having burned innocent women as witches, and of having needlessly tortured prisoners, criminals, and slaves. In his book, "The French Quarter," Herbert Asbury describes some of the tortures that were carried out in the early days of New Orleans, as follows: "Two of the doomed men were broken on the wheel, which means that they were spread-eagled to a wheel-like contraption, and their bones were broken one by one with sledge hammers. The third was nailed alive in a coffin and the coffin was then sawed in two." Yes, we have sinned against humanity, too, and in the name of war and glory to flag and country, we have indulged in slaughter and carnage, with all the rest. Even the women have had their Amazons who gloried in battle.

It is natural, though, in terrible times like this, for men of good will to doubt and to despair. They have always done it. Many

centuries ago, when the world he had known was falling into decay, Boethius, a Roman philosopher, wrote:

> "And therefore whoso seeks the truth
> Shall find in no wise peace of heart."

Our own poet, Walt Whitman, who has affirmed more triumphantly than any other his faith in America and its future, and in the immortality of man, wrote, during the dark days of the Civil War:

> "Year that trembled and reeled beneath me!
> Your summer wind was warm enough, yet the air I breathed, froze me;
> A thick gloom fell through the sunshine and darkened me;
> Must I change my triumphant songs? said I to myself;
> Must I indeed learn to chant the cold dirges of the baffled?
> Their solemn hymns of defeat?"

We know that he did not succumb to learning "to chant the cold dirges of the baffled," for a little later, he sang;

> "Long, too long. O Land,
> Travelling roads all even and peaceful you learned from joys and prosperity only;
> But now, ah now, to learn from crises of anguish—advancing,
> Grappling with direst fate and recoiling not."

We physicians are trained by all our experiences to "recoil not" in the face of danger, disease, and death. We know that in times of sickness and disaster we see the individual man at his most craven and helpless and unreasoning, but we know that, intermingled with these weaknesses, we also see at these times the utmost in human courage and selflessness. Likewise we know that the noblest aspects of man's nature emerge triumphant above the rubble and ruin of war and desolation. Our knowledge of all these things allays our fears, and gives us the faith and confidence we are needing in these days.

For if we know, and must concede, that the viciousness and cruelty that is part of man is taking new and terrifying shapes and forms, we also know, and must not forget to affirm, that the forces of the good have never been so strong and so enlightened as they are to-day. If the resources of science are being prostituted to the uses of torture, destruction, and terrible death, they also are available to assuage the suffering and hopelessness of the innocent. Dr. Carrel has said: "For the first time in history, a crumbling civilization is capable of discerning the causes of its decay. For the

first time it has at its disposal the gigantic strength of science."

It is a tremendous challenge that men of science, especially American men of science, face to-day. The soldiers, the shopkeepers, and even the clergy have failed to find a remedy for the ills of the world, and to-day, as never before, the people are turning to the scientists for hope. The evidence of this trend is recurring constantly in our literature. It might be interesting to cite a couple of examples.

Anne Morrow Lindbergh, in her recent book, "The Wave of the Future," says:

> "Man has never conquered the underlying forces of nature. But he has learned to understand these forces, to move erect among them, and to use them for his own ends. He cannot stop or bring the storms; but he can irrigate the desert and dam the flood. He cannot successfully defy nature, but he is able to follow, influence, and speed her course. And in doing so he has learned to halt disease, to lessen suffering, and to increase his capacities for health and the appreciation of life.
> "Before he learned to use these natural forces, he was hopelessly at their mercy. He had to bow blindly before them or be swept along in their path. To-day, is it not conceivable that he must again learn to use forces growing in the world—human forces this time; that he must learn not to resist the inevitable push of progress, but to make his life conform to it?"

In the beautiful play, "There Shall Be No Night," by Robert Sherwood, it is significant that the author chose as his central character a physician who had received the Nobel prize for his researches, and that he voiced his faith in science as follows:

> "Listen! What you hear now—this terrible sound that fills the earth—it is the death rattle. One may say easily and dramatically that it is the death rattle of civilization. But I choose to believe differently. I believe it is the long deferred death rattle of the primordial beast. We have within ourselves the power to conquer bestiality, not with our muscles and our swords, but with the power of the light that is in our minds. What a thrilling challenge this is to all science! To play its part in the ultimate triumph of evolution! To help speed the day when man becomes genuinely human instead of the synthetic creature, part bogus angel, part actual brute, that he has imagined himself in the dark past!"

Yes, all the pitiable creatures of this world, the maimed, the helpless, the hungry, the arrogant, the ignorant, and the weak, are looking to us, as scientists and physicians, to help them, to bind their wounds, and to show them the way to a better life in the future. And we will not fail them in their helplessness.

The physician has always sacrificed himself to serve his fellows and to relieve their suffer-

ing. Even without the armor of knowledge we now possess, when he had little to offer but human sympathy and assurance, he braved the dangers of battle, filth, pestilence, and raging storms, to aid and succor the sick and the dying. This noble tradition has been bequeathed to us by all our predecessors who underwent any hardship to preserve the flickering flame of humanity and truth through all the dark caverns of ignorance and degradation.

In fulfilling our duties to our fellows, we can take pride also in the part that has been played by organizations like this, in which we are united in an association of mutual interest and friendship, to increase our usefulness, and not to seek special privileges for ourselves.

In recent years, however, despite the underlying motive of service, we have perhaps been inclined to stress the contributions of knowledge and of the mind, and to overlook somewhat the traditions of the spirit which have always been so large a part of the physician's contribution to the life around him. Specialization and the modern organization of medical practice have denied us some of the intimate personal relationships that characterized the function of the family physician.

In these times, especially, we must renew and reaffirm our faith in the spiritual, as well as the scientific traditions, of our profession, and we must remember that the first duty of the physician is to be a friend to man. An all-abiding love for all our fellows should be the wellspring of our activities, and this love may be expressed in a thousand ways. "Let no man seek his own, but each his neighbor's good." Many of our own number, no doubt, may be called to service in defense of our na-

tion. Let those of us who are left at home see that their interests are protected, and let us keep their places ready for them on their return.

As physicians, let us remember that if we love our fellow men, there can be no place in our hearts for the degrading and destructive influence wrought by hate and intolerance. If we deserve the name of friend, we shall not be guilty of petty prejudices and vengeful desires. We shall pity our enemies for their weaknesses and ignorance, and shall strive to deal with them justly. And we shall work unceasingly to relieve all who suffer, everywhere.

In closing, I'm going to quote a few lines from St. Paul, because I believe it is good for us from time to time to refresh ourselves with the wisdom that is to be found in the Bible, and because the words I have chosen provide an eloquent summary of all I have been trying to say.

The first of these were quoted by the doctor in Sherwood's play:

"We glory in tribulation; knowing that tribulation worketh patience; and patience, experience; and experience, hope."

And then the following, from the First Letter to the Corinthians:

"If I speak with the tongues of men and of angels, but have not love, I am become as sounding brass, or a clanging cymbal. And if I have the gift of prophesy and know all mysteries and all knowledge, and if I have all faith so as to remove mountains, and have not love, I am nothing. . . . But now abideth faith, hope, love, these three; and the greatest of these is love."

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MASS CHEST SURVEYS[1]

Like ancient Gaul, the subject of group surveys for the recognition of tuberculosis divides itself naturally into three parts. These are: (1) Should such surveys be undertaken (*i.e.*, are they of sufficient value to the community to warrant the necessary expenditure of time, effort and money)? (2) How, in general, are such surveys made (*i.e.*, under what auspices, by whom and in what technical fashion)? (3) How do we think they should be made?

To obtain information that would assist in formulating an answer to each of these questions, the Inter-Society Committee for Radiology has recently surveyed the situation and the preponderance of opinion among qualified observers throughout the country by means of a questionnaire. Replies were received from State representatives of the Committee and secretaries of regional radiological societies in forty States.

We could easily devote a great deal of time to the discussion of the question, "Should such surveys be undertaken?" Most—or at least many—of us would be inclined to answer in the negative and there is much to support such an answer. When it is remembered that only from 0.25 to 0.50 per cent of children examined are found to have open cases of tuberculosis and there are no uniform regulations for requiring either isolation or treatment of those discovered; when it is remembered that surveys of school children (certainly those most commonly surveyed) ignore the teacher, the nurse, the cafeteria attendant, and the food handler, one might be justified in considering the method a little extravagant.

A recent issue of the *Journal of the American Medical Association* pointed out that in the eastern part of the country about 60 per cent of patients in tuberculosis sanitaria voluntarily discharge themselves even though bacilli are being found regularly in their sputa. Garland's pertinent comment on this is that it seems futile to make expensive efforts to catch a few open cases on the left-hand side of the room and to allow 60 per cent of those you catch to walk out through the right-hand side to mingle with and infect the populace at large.

Surveys do, of course, create a group consciousness about tuberculosis. Their chief value undoubtedly is educational. Unfortunately, however, our discussion of this question is a purely academic one since the matter has been settled for us by the various foundations, health agencies, and tuberculosis associations who conduct these surveys, and we can better employ our time in discussion of the second question, "How, in general, are such surveys made?"

By this question we mean to inquire as to the agencies conducting mass surveys; the means by which they are conducted; the medical and particularly the roentgenological personnel; and the medical and again particularly the roentgenological value of these findings.

Questions which particularly concern us are: (1) Should surveys be on a mass or group basis, or performed by radiologists on an individual basis? And (2) how should the radiologist be compensated?

Most of the rather extensive comment which was received by the Inter-Society Committee dealt with one or both of these questions.

Surveys are conducted by State and local tuberculosis associations; by State and local boards of health, boards of education and similar official and quasi-official bodies. In some instances, industrial insurance carriers or large-scale employers have also undertaken group surveys.

In the majority of instances—at least in those reported to the Committee from various sections of the country—they have been actually made by these agencies just mentioned through paid professional employees and with their own technical equipment.

Some surveys have been made by contract with commercial agencies, notably the Powers

Company, and in a few instances they have been carried out with the cooperation of local radiologists.

The majority of surveys seem to have been made by making ordinary postero-anterior roentgenograms; some have used roentgeno-graphic paper, and a smaller but increasing number have employed fluoro-photographic methods.

The value of any one of these methods depends absolutely upon two factors: (1) the technical quality of the roentgenogram produced, and (2) the training and experience of the observer who interprets it.

There seems to be no expressed general dis-satisfaction with these two factors and apparently and in general the technical quality of roentgenograms produced is at least average, while the training and experience of the observer seem to be considered adequate.

These conclusions are based on statements by radiologists, of which the following are random samples:

"The unit includes a physician who is fairly well trained in interpretation of chest films". . . . ". . .an exceptionally well trained man and I think the work was done very well indeed when the circumstances are considered."

"It might be possible to arrange for a radiologist to supervise the interpretations but I doubt. . . . . if the interpretation would be any more accurate for Dr. —— has had unusually wide experience."

At this point it will be well to recapitulate the conclusions thus far justified by the factual reviews attempted by your Committee, and these conclusions are:

In spite of a fairly widespread feeling that group or mass surveys are more spectacular than useful, they are being made and will continue to be made. Surveys are in most part conducted by official bodies employing their own personnel. Ordinary x-ray films are chiefly used, but fluoro-photographic methods are being increasingly employed.

There now remains for us to consider the third question: "How do we think surveys should be made?"

An important and frequently overlooked consideration is this: A survey should be—and thoroughly understood to be—a mass survey, and not a series of complete roentgen diagnoses. That is to say that the function of a survey is, or should be, to eliminate the healthy from consideration so that those who need regular roentgen examination of the chest may be identified. If this criterion were con-stantly in the minds of the survey makers, we would need have little concern with the details and methods of surveying, but unfor-tunately "survey" and "regular diagnosis" seem to be pretty well confused, and perhaps in straightening out these confused ideas the College can be of real service to the community.

In Bulletin III, the Air Hygiene Foundation devotes an entire page to the prominent dis-play of a statement, credited to Pendergrass and Hode, in which they emphasize the neces-sity of roentgen study of the lungs of those not dismissed as normal by survey methods and this needs continual emphasis. We may then repeat (commencing to answer our third ques-tion) that we think surveys should remain pre-liminary diagnostic surveys and not regular diagnostic measures.

Undoubtedly the best way to conduct mass surveys of school children or industrial groups would be by cooperation between loca radiolo-gists and anti-tuberculosis associations. If the groups to be surveyed could be divided into small sub-groups and sent to radiologists' offices, we would have the ideal solution. Fail-ing this ideal, roentgenograms of those included in a survey should be studied by a radiologist or (perhaps better) by a group of radiologists or of radiologists and tuberculosis specialists. Certainly this important work should not be entrusted to the young and unskilled physicians who are ordinarily hired for survey work.

There is, of course, no reason why a radiolo-gist or any other physician should contribute his services to a community venture. This does not mean that the physician is unwilling to cooperate or to carry his share of any burden; it only means that in any joint project of a community the physician's rôle is that of a good citizen of like social and financial stand-ing, but it is as absurd for the community to expect him to donate his services as to expect the same of the film manufacturer, the nurse, the driver of the camion, or any other person properly earning his bread by his efforts.

In spite of these obvious facts, however, if the other physicians engaged in such a com-munal enterprise are giving their services, the radiologist risks setting himself apart from his profession by his refusal to do likewise. Several approaches to the solution of this problem have been attempted.

In Florida the State Board of Education and the State Board of Health advise chest x-ray examinations for all school employees and

provide that it may be made by any doctor of medicine. The fee is left to private treaty.

In New Jersey the examiner "may be the school medical inspector or one or more physicians engaged for that purpose," and the State Board of Health rules provide that "x-ray work may be purchased from tuberculosis sanitaria, local general hospitals, local roentgenologists or commercial agencies," and the "purchaser" is urged to inquire of the commercial agencies whether the price quoted includes the reading of the x-ray film.

When such poor comprehension of the problem is encountered, one wonders whether the survey conducted directly by a State Board of Health would not be preferable.

In Monmouth County, New Jersey, however, the tuberculosis committee of the County Medical Society, comprising radiologists and tuberculosis specialists, furnishes interpretations of films made by a survey agency, and this plan is commended.

Your Committee recommends that:

1. The existence of mass surveys as going concerns be recognized as an accomplished fact.

2. That radiologists be urged to lend themselves to such surveys as are truly community efforts on the same terms as their fellow practitioners.

3. That the plan of the Monmouth, New Jersey, County Medical Society be commended.

4. That the College constantly insist on the recognition of the survey as an initial crude diagnostic survey and not as a series of regular diagnoses.

ANNOUNCEMENTS

AMERICAN SOCIETY OF X-RAY TECHNICIANS

The Sixteenth Annual Convention of The American Society of X-Ray Technicians will be held in Hollywood, California, June 17–20, 1941, with the Roosevelt Hotel, Hollywood, as headquarters.

PENNSYLVANIA RADIOLOGICAL SOCIETY

The Pennsylvania Radiological Society will hold its next annual meeting at the William Penn Hotel in Pittsburgh, Pa. May 16–17, 1941.

IN MEMORIAM

FRANK W. LAMB, M.D.

Dr. Frank Lamb, dean of roentgenologists of the State of Maine, died on January 20, 1941, of a heart attack at his home in Portland. He received his M.D. degree from the University of Maine in 1895 and has practised in Portland since 1900.

Dr. Lamb was roentgenologist to the Children's Hospital, the State Street Hospital, and the Queen's Hospital in Portland. He was also consulting roentgenologist to the Webber and Trull Hospitals in Biddeford, St. Mary's Hospital in Lewiston, and the Maine General Hospital in Portland. He was a member of the Radiological Society of North America and counselor for the State of Maine, a member of the American Roentgen Ray Society, and a Diplomate of the American Board of Radiology.

CHARLES NICHOLAS OLSEN LEIR, M.D.

Dr. Charles N. O. Leir, died on September 22, 1940, at the Veterans Hospital in Des Moines, of a heart ailment. Dr. Leir was graduated in 1901 from Drake University College of Medicine and practised in Des Moines. He was a member of the Radiological Society of North America and a life member of the Polk County and Iowa State Medical Societies.

BOOK REVIEWS

AGE MORPHOLOGY OF PRIMARY TUBERCLES. By HENRY C. SWEANY, M.D., Medical Director of Research, Municipal Tuberculosis Sanitarium, Chicago, and Research Associate, Department of Physiology, University of Chicago. A volume of 265 pages with numerous charts and illustrations. Published by Charles C. Thomas, Springfield, Illinois, 1941. Price: $5.00.

For many years Dr. Henry C. Sweany, author of "Age Morphology of Primary Tubercles," has been Medical Director of Research in the laboratories of the Municipal Tuberculosis Sanitarium in Chicago, and Research Associate in the Department of Physiology of the University of Chicago. He is eminently qualified to speak authoritatively on the broad subject of tuberculosis and especially to describe those tuberculous formations of primary localization which have been called primary or Ghon tubercles.

A wealth of material has been at his disposal and the lesions have been studied from various points of view, including their clinical, pathologic, roentgenologic and medico-legal aspects. During the past ten years the author has, from time to time, published reports of this research as it advanced from stage to stage. With the completion of his work all published and unpublished data have been accumulated and now appear in book form.

His principal work was done in an effort to prove the relationship of age to morphology of primary tubercles. He has shown that, as in all related biologic phenomena, the formation, maturation, and regression of primary tubercles are regulated by definite laws and occur in regular intervals of time. For example, he shows that reticulin forms in two to three months, the specific capsule of Aschoff in about one year, and that the whole capsule including the middle capsule is thickest at eight years. From cases in which the date of formation is known he proves that calcification occurs in a year and that fibrophage cells change to bone cells in about ten years. Bone is shown to be a rare component of the tubercle before ten years but is common after the tubercle has reached the age of twenty years.

In the chapter describing the age criteria of primary tubercles revealed by roentgenologic studies use has been made of the

facts related to the proved rhythmic cycles of growth and development to make possible an estimate of the age of lesions pictured on the film. The clinical investigator will be especially impressed by the interesting observations the author has made, because roentgenologic evidence is all that is available for study of chronic primary lesions during the lifetime of the patient.

The establishment of the age morphology of primary tubercles has many advantages. It presents a means for tracing the onset of tuberculous infection back to childhood or even to infancy, and makes possible the prediction of time relationships of reinfection. From such data the tuberculous persons responsible for infection or reinfection can be identified.

The age morphology of the tubercle is useful not only in the study of public health problems, but also in Veterans Bureau compensation departments and in the inquiries of governmental agencies in cases of deportation of aliens.

The subject matter in this book is logically arranged and beautifully illustrated. It is written clearly and concisely, and summaries and conclusions complete each chapter. It is a valuable work based upon a novel theory and should be read with satisfaction by pathologists and clinicians and all others interested in the study of tuberculosis.

DIAGNOSIS AND TREATMENT OF MENSTRUAL DISORDERS AND STERILITY. By CHARLES MAZER, M.D., F.A.C.S., Assistant Professor of Gynecology and Obstetrics, Graduate School of Medicine, University of Pennsylvania; Gynecologist to the Mount Sinai Hospital, Philadelphia, and S. LEON ISRAEL, M.D., F.A.C.S., Instructor in Gynecology and Obstetrics, School of Medicine, University of Pennsylvania; Associate Gynecologist to the Mount Sinai Hospital, Philadelphia. A volume of 485 pages with 108 illustrations. Published by Paul B. Hoeber, Inc., Medical Book Department of Harper & Brothers, New York City, 1941. Price: $6.50.

Another book has been written to guide the general practitioner through the maze of endocrinology as it applies to the reproductive system of the human female. On the whole the authors have done a good job of it. They have avoided dogmatism, though naturally quoting their own experiences and opinions gained by a wide practice in the field of gynecology. A copious and representative bibliography appears with each subject and augments the value of the work. One familiar with the material of the book and of the field it represents may question some statements and seriously disagree with others. For example, one cannot agree that migraine is only to be explained on an allergic basis and must seriously challenge the advisability of ever treating with hormones a breast that has produced bleeding from the nipple.

The publishers have turned out an easily read and well gotten up volume. It contains 485 pages and 88 figures consisting of photographs, charts, photomicrographs, differential diagnosis tables, reproductions of specimens, etc.

This volume is divided into thirty chapters some of which are quite short but seem to serve the purpose of emphasizing various subjects. The first four chapters are devoted to a review of physiological facts necessary for the understanding of the abnormal states to be discussed later, though various phases of abnormal pubertal development are considered in chapter two. Chapters three and four are devoted to the normal menstrual cycle. In the discussion of menstrual hormone balance a chart of the excretion levels of estrogens during the menstrual cycle is shown that is at variance with curves reported by other investigators in that a gradual increase is shown until the onset of menstruation, whereas others have found that a more rapid increase occurs up to the time of ovulation, followed by another peak and a more rapid fall before the onset of menstruation.

Chapter five is devoted to a discussion of dysmenorrhea and is followed by chapters on premenstrual tension, migraine, breast hyperplasia, intermenstrual pain and vicarious menstruation. The management of dysmenorrhea is covered in a manner thorough enough to familiarize the reader with the present-day concept of the treatment of this condition. One is glad to note the recognition and discussion of premenstrual tension states even though the exact etiology of this condition is not yet conclusively proved.

Forty-three pages compose the eleventh chapter, devoted to a discussion of amenorrhea due to pituitary derangements. In this chapter appears a discussion of the standardization of estrogens and mention is made of the various

estrogens used in clinical practice, including the synthetic product, stilbestrol. Following this chapters twelve to sixteen discuss amenorrhea in relation to ovarian, uterine, thyroid, adrenal, and nervous disorders.

With chapter eighteen the authors begin the discussion of uterine bleeding with emphasis on the systemic and organic lesions responsible for this symptom, laying particular stress on the diagnosis of malignant lesions of the genital tract. With chapter twenty the dysfunctional uterine bleedings are introduced. The etiology and diagnosis are amply covered and the treatment, according to the authors' ideas, is outlined very completely.

Chapters twenty-two to thirty deal with all the aspects of sterility in both female and male, including a chapter on habitual abortion. An appendix covers the commercially available standardized hormone products.

This volume should make a worth-while addition to one's library. It must be realized that the subject contains many controversial aspects, but the authors have a wide experience as a basis for their book.

RADIOLOGIC PHYSICS. By CHARLES WEYL, S. REID WARREN, JR., and DALLETT B. O'NEILL, Moore School X-ray Laboratory, Moore School of Electrical Engineering and University of Pennsylvania. With a Foreword by EUGENE P. PENDERGRASS, M.D., Director of the Department of Radiology, University of Pennsylvania. A volume of 459 pages, illustrated with 158 figures, 25 tables and an appendix containing many mathematical equations and tables. Published by Charles C. Thomas, Springfield, Illinois, 1941. Price: $5.50.

This book is designed to lead the beginner with no knowledge of physics or mathematics by logical, complete, and systematic stages through theoretical electrical engineering and radiation physics to a firm foundation in practical radiology. The book is well organized, carefully written, and beautifully produced, with a complete index and an abundant bibliography. At first glance the text looks formidable, but this is only apparent, for mathematical considerations have been reduced to a minimum and the conceptions which might be confusing are clarified by a section on the elements of mathematics. One tries in vain to think of an important omission or of a change in emphasis of the subject matter.

This book surpasses all texts on radiologic physics and should be owned and studied by all radiologists and teachers and students of radiology.

MANUAL OF CLINICAL CHEMISTRY. By MIRIAM REINER, M.Sc., Assistant Chemist to The Mount Sinai Hospital, New York City. A volume of 296 pages with 18 illustrations. Published by Interscience Publishers, Inc., New York, 1941. Price: $3.00.

This excellent manual of laboratory procedures applicable to clinical medicine is an outgrowth of condensed descriptions of technic previously prepared for use in the laboratory of Mount Sinai Hospital by internes called on to carry out routine chemical determinations.

Procedures are presented for the determinations commonly utilized in the examination of blood, urine, cerebrospinal fluid, feces, and gastric content. In addition, many functional tests are described. Methods are outlined for the determination of sex hormones in blood and urine and for several vitamins for which standard procedures have been elaborated.

Anyone engaged in clinical laboratory work who desires a condensed description of accepted procedures will find this manual of decided help. In instances where the condensed version is too brief the original description can be consulted and this may be necessary in occasional cases where essential details have been sacrificed for the sake of brevity.

In general, the selection of methods is most commendable and the reviewer noted very few instances where other methods might be found preferable to those given for use in a clinical laboratory. For example, the Kingsley method for the determination of albumin-globulin ratio gives results more quickly and more accurately than the method described. Also the use of boric acid and combined indicator as a receiver for the ammonia in Kjeldahl determinations and urea aerations obviates one standard solution. The description for the preparation of glucose to be administered intravenously seems excessively complicated for the individual hospital.

The reviewer can recommend this manual for hospital laboratories and for technicians engaged in clinical biochemistry but would urge that in those instances in which the description is excessively brief the original procedure be consulted.

RADIOLOGICAL SOCIETIES IN NORTH AMERICA

UNITED STATES

CALIFORNIA

California Medical Association, Section on Radiology.—*Chairman,* Carl H. Parker, M.D., 65 N. Madison Ave., Pasadena; *Secretary,* Wilbur Bailey, M.D., 2007 Wilshire Blvd., Los Angeles.

Los Angeles County Medical Association, Radiological Section.—*President,* M. L. Pindell, M.D.; *Vice-president,* Richard T. Taylor, M.D.; *Secretary,* Wilbur Bailey, M.D., 2007 Wilshire Blvd.; *Treasurer,* Henry Snure, M.D., 1414 South Hope Street; Kenneth Davis, M.D., *Member of Executive Committee.* Meets second Wednesday of each month at County Society Building.

Pacific Roentgen Society.—*Chairman,* William E. Costolow, M.D., Los Angeles; *Members of Executive Committee,* I. S. Ingber, M.D., San Francisco; D. R. MacColl, M.D., Los Angeles, and J. D. Coate, M.D., Oakland; *Secretary-Treasurer,* L. Henry Garland, M.D., 450 Sutter St., San Francisco. Executive Committee meets quarterly; Society meets annually during annual meeting of the California Medical Association.

San Francisco Radiological Society.—*Secretary,* Harold A. Hill, M.D., 450 Sutter Street. Meets monthly on third Thursday at 7:45 P.M., for the first six months at Toland Hall (Univ. of Calif. Med. School) and for the second six months at Lane Hall (Stanford Univ. School of Med.).

COLORADO

Denver Radiological Club.—*President,* N. B. Newcomer, M.D., 306 Republic Bldg.; *Vice-president,* Elizabeth Newcomer, M.D.; *Secretary,* Paul R. Weeks, M.D., 520 Republic Bldg.; *Treasurer,* L. G. Crosby, M.D., 366 Metropolitan Bldg. Meets third Friday of each month at homes of members.

CONNECTICUT

Connecticut State Medical Society, Section on Radiology.—*Chairman,* Owen J. Groark, M.D., 881 Lafayette St., Bridgeport; *Secretary-Treasurer,* Max Climan, M.D., 242 Trumbull St., Hartford. Meetings bimonthly, on second Thursday. Place of meeting selected by Secretary.

DELAWARE

Affiliated with Philadelphia Roentgen Ray Society.

FLORIDA

Florida Radiological Society.—*President,* J. H. Lucinian, M.D.; *Vice-president,* John N. Moore, M.D.; *Secretary-Treasurer,* Elliott M. Hendricks, M.D., 314 Sweet Bldg., Fort Lauderdale. The next meeting will be at the time of the annual meeting of the Medical Association of Florida in the spring.

GEORGIA

Georgia Radiological Society.—*President,* Robert Drane, M.D., DeRenne Apts., Savannah; *Vice-president,* J. J. Collins, M.D., Archbold Hospital Thomasville; *Secretary-Treasurer,* Robert C. Pendergrass, M.D., Prather Clinic Bldg., Americus. Meetings twice annually, in November and at the annual meeting of the Medical Association of Georgia in the spring.

ILLINOIS

Chicago Roentgen Society.—*President,* Adolph Hartung, M.D.; *Vice-president,* Warren W. Furey, M.D.; *Secretary,* Chester J. Challenger, M.D., 3117 Logan Blvd. The Society meets at the Palmer House on the second Thursday of October, November, January, February, March, and April.

Illinois Radiological Society.—*President,* Harry W. Ackeman, M.D., 321 W. State St., Rockford; *Vice-president,* D. R. Hanley, M.D., St. Mary's Hospital, Streator; *Secretary-Treasurer,* William DeHollander, M.D., St. John's Hospital, Springfield. Meetings quarterly by announcement.

Illinois State Medical Society, Section on Radiology.—*Chairman,* Harry W. Ackeman, M.D., 321 W. State St., Rockford; *Secretary,* Earl E. Barth, M.D., 303 E. Chicago Ave., Chicago.

INDIANA

The Indiana Roentgen Society.—*President,* H. H. Inlow, M.D., Shelbyville; *President-elect,* Charles Wyeth, M.D., Terre Haute; *Vice-president,* C. A. Stayton, M.D., Indianapolis; *Secretary-Treasurer,* Clifford C. Taylor, M.D., 23 E. Ohio St., Indianapolis. Annual meeting in May.

IOWA

The Iowa X-ray Club.—Holds luncheon and business meeting during annual session of Iowa State Medical Society.

KENTUCKY

Kentucky Radiological Society.—*President,* D. B. Harding, M.D., Lexington; *Vice-president,* I. T. Fugate, M.D., Louisville; *Secretary-Treasurer,* Joseph C. Bell, M.D., 402 Heyburn Bldg., Louisville. Meeting annually in Louisville, third Sunday afternoon in April

LOUISIANA

Shreveport Radiological Club.—*President,* C. P. Rutledge, M.D.; *Vice-president,* S. C. Barrow, M.D.; *Secretary-Treasurer,* W. R. Harwell, M.D. Meetings monthly on the second Wednesday, at the offices of the various members.

MAINE

See New England Roentgen Ray Society.

MARYLAND

Baltimore City Medical Society, Radiological Section.—Chairman, John W. Pierson, M.D., 1107 St. Paul St.; *Secretary*, Walter L. Kilby, M.D., 101 W. Read St. Meetings are held the third Tuesday of each month.

The Thirty-first Annual Midwinter Conference of Eastern Radiologists will meet in Baltimore on Jan. 31 and Feb. 1, 1941.

MASSACHUSETTS

See New England Roentgen Ray Society.

MICHIGAN

Detroit X-ray and Radium Society.—President. O. J. Shore, M.D., 552 Fisher Bldg., Detroit; *Vice-president*, Clarence E. Hufford, M.D., 421 Michigan St., Toledo, Ohio; *Secretary-Treasurer*, E. R. Witwer, M.D., Harper Hospital, Detroit. Meetings first Thursday of each month from October to May, inclusive, at Wayne County Medical Society club rooms, 4421 Woodward Ave., Detroit.

Michigan Association of Roentgenologists.—President, J. H. Dempster, M.D., Detroit; *Vice-president*, L. E. Holly, M.D., Muskegon; *Secretary-Treasurer*, J. E. Lofstrom, M.D., 1536 David Whitney Bldg., Detroit. Meetings quarterly by announcement.

MINNESOTA

Minnesota Radiological Society.—President, Harry Weber, M.D., Mayo Clinic, Rochester; *Vice-president*, G. T. Nordin, M.D., Minneapolis; *Secretary*, John P. Medelman, M.D., 572 Lowry Medical Arts Bldg., St. Paul. Meetings quarterly.

MISSOURI

The Kansas City Radiological Society.—President, Galen M. Tice, M.D., Univ. of Kansas Hospitals, Kansas City, Kansas; *Secretary*, P. E. Hiebert, M.D., 907 North Seventh St. (Huron Bldg.), Kansas City, Kansas. Meetings last Thursday of each month.

The St. Louis Society of Radiologists.—President, Oscar C. Zink, M.D., St. Luke's Hospital; *Secretary*, Wilbur K. Mueller, M.D., University Club Bldg. Meets on fourth Wednesday of October, January, March, and May, at a place designated by the president.

NEBRASKA

Nebraska Radiological Society.—President, H. A. Scott, M.D., Veterans Administration Facility, Lincoln; *Secretary*, D. A. Dowell, M.D., 816 Medical Arts Bldg., Omaha. Meetings third Wednesday of each month at 6 P.M. in either Omaha or Lincoln.

NEW ENGLAND ROENTGEN RAY SOCIETY

(Maine, New Hampshire, Vermont, Massachusetts, and Rhode Island.) *Secretary*, Hugh F. Hare, M.D., Lahey Clinic, Boston Mass. Meets monthly on third Friday at Boston Medical Library.

NEW HAMPSHIRE

See New England Roentgen Ray Society.

NEW JERSEY

Radiological Society of New Jersey.—President, James G. Boyes, M.D., 912 Prospect Ave., Plainfield; *Vice-president*, Nathan J. Furst, M.D., 190 Johnson Ave., Newark; *Secretary*, W. James Marquis, M.D., 198 Clinton Ave., Newark; *Treasurer*, H. A. Vogel, M.D., 1060 East Jersey St., Elizabeth, and *Counsellor*, H. J. Perlberg, M.D., 921 Bergen Ave., Jersey City. Meetings at Atlantic City at time of State Medical Society and Midwinter in Newark as called by president.

NEW YORK

Associated Radiologists of New York, Inc.—President, I. J. Landsman, M.D., 910 Grand Concourse, New York City; *President-elect*, D. E. Ehrlich, M.D., 35 West 92nd St., New York City; *Vice-president*, Frederic E. Elliott, M.D., 122 76th St., Brooklyn; *Treasurer*, Solomon Fineman M.D., 133 East 58th St., New York City; *Secretary*, William J. Francis, M.D., 210 Fifth Ave., New York City. Regular meetings the first Monday evening of the month in March, May, October, and December.

Brooklyn Roentgen Ray Society.—President, A. L. L. Bell, M.D., Long Island College Hospital, Henry, Pacific, and Amity Sts.; *Secretary-Treasurer*, L. J. Taormina, M.D., 1093 Gates Ave. Meetings held the fourth Tuesday of every month, October to April.

Buffalo Radiological Society.—President, Edward Koenig, M.D., 100 High St., Buffalo; *Vice-president*, W. Roger Scott, M.D., 598 Pine St., Niagara Falls; *Secretary-Treasurer*, Joseph S. Gian-Franceschi, M.D., 610 Niagara St. Meetings second Monday evening each month, October to May, inclusive.

Central New York Roentgen Ray Society.—President. Albert Lenz, M.D., 613 State St.. Schenectady; *Vice-president*, Dwight V. Needham, M.D., 123 Sedgwick St., Syracuse; *Secretary-Treasurer*, Carlton F. Potter, M.D., 425 Waverly Ave., Syracuse. Meetings are held in January, May, and October, as called by Executive Committee.

Long Island Radiological Society.—President, Samuel G. Schenck, M.D., Brooklyn; *Vice-president*, G. Henry Koiransky, M.D., Long Island City; *Secretary*, Marcus Wiener, M.D., 1430 48th St., Brooklyn; *Treasurer*, Louis Goldfarb, M.D., 608 Ocean Ave., Brooklyn Meetings fourth Thursday evening each month at Kings County Medical Bldg.

New York Roentgen Society.—President, Henry K. Taylor, M.D., 667 Madison Ave., New York City;

Vice-president, Roy D. Duckworth, M.D., 170 Maple Ave., White Plains, N. Y.; *Secretary*, Eric J. Ryan, M.D., St. Luke's Hospital, New York City, and *Treasurer*, Paul C. Swenson, M.D., 168th St. and Broadway, New York City.

Rochester Roentgen-ray Society.—Chairman, George H. S. Ramsey, M.D., 277 Alexander St.; *Secretary*, S. C. Davidson, M.D., 277 Alexander St. Meetings at convenience of committee.

NORTH CAROLINA

Radiological Society of North Carolina.—President, Robert P. Noble, M.D., 127 W. Hargett St., Raleigh; *Vice-president*, A. L. Daughtridge, M.D., 144 Coast Line St., Rocky Mount; *Secretary-Treasurer*, Major I. Fleming, M.D., 404 Falls Road, Rocky Mount. Meetings with State meeting in May, and meeting in October.

OHIO

Ohio Radiological Society.—President, U. V. Portmann, M.D., Cleveland; *Secretary*, J. E. McCarthy, M.D., Cincinnati. A committee was appointed to draw up a constitution and by-laws. The next meeting will be held at the time and place of the annual meeting of the Ohio State Medical Association.

Cleveland Radiological Society.—President, L. A. Pomeroy, M.D., Hanna Bldg., Cleveland; *Vice-president*, P. C. Langan, M.D., 215 Wellesley Ave., Akron; *Secretary-Treasurer*, H. A. Mahrer, M.D., 10515 Carnegie Ave., Cleveland. Meetings at 6:30 P.M. at the Mid-day Club, in the Union Commerce Bldg., on fourth Monday of each month from October to April, inclusive.

Radiological Society of the Academy of Medicine (Cincinnati Roentgenologists).—*President*, Samuel Brown, M.D.; *Secretary-Treasurer*, Justin E. McCarthy, M.D., 707 Race St. Meetings held third Tuesday of each month.

PENNSYLVANIA

Pennsylvania Radiological Society.—President, H. Norton Mawhinney, M.D., Pittsburgh; *President-elect*, Peter B. Mulligan, M.D., Ashland; *First Vice-president*, Harold S. Callen, M.D., Bradford; *Second Vice-president*, Harold W. Jacox, M.D., Pittsburgh; *Secretary-Treasurer*, L. E. Wurster, M.D., 416 Pine St., Williamsport; *Editor*, William E. Reiley, M.D., Clearfield; *Assistant Editor*, Sydney J. Hawley, M.D., Danville; *Censor for Three Years*, A. R. Snedden, M.D., McKeesport. The Society meets annually; time and place of next meeting will be announced later.

The Philadelphia Roentgen Ray Society.—President, Jacob H. Vastine, II, M.D., Medical Arts Bldg., Philadelphia; *Vice-president*, A. Maxwell Sharpe,

M.D., 708 Sproul St., Chester; *Secretary*, Barton R. Young, M.D., Temple University Hospital, Philadelphia; *Treasurer*, Fay K. Alexander, M.D., Chestnut Hill Hospital, Philadelphia. Meetings held first Thursday of each month at 8:15 P.M., from October to May, in Thomson Hall, College of Physicians, 21 S. 22nd St., Philadelphia.

The Pittsburgh Roentgen Society.—President, Paul G. Bovard, M.D., 306 Corbett St., Tarentum, Pa.; *Vice-president*, John H. Gemmell, M.D., 262 Connecticut Ave., Rochester, Pa., and *Secretary-Treasurer*, Harold W. Jacox, M.D., 4800 Friendship Ave., Pittsburgh, Pa. Meetings are held on the second Wednesday of each month at 4:30 P.M., from October to June, at the Pittsburgh Academy of Medicine, 322 N. Craig St.

RHODE ISLAND

See New England Roentgen Ray Society.

SOUTH CAROLINA

South Carolina X-ray Society.—President, T. A. Pitts, M.D., Columbia; *Secretary-Treasurer*, Malcolm Mosteller, M.D., Columbia Hospital, Columbia. Meetings in Charleston on first Thursday in November, also at time and place of South Carolina State Medical Association.

SOUTH DAKOTA

Meets with Minnesota Radiological Society.

TENNESSEE

Memphis Roentgen Club.—Chairmanship rotates monthly in alphabetical order. Meetings second Tuesday of each month at University Center.

Tennessee Radiological Society.—President, Eugene Abercrombie, M.D., 305 Medical Arts Bldg., Knoxville; *Vice-president*, Christopher C. McClure, M.D., 404 Doctors Bldg., Nashville; *Secretary-Treasurer*, Franklin B. Bogart, M.D., 311 Medical Arts Bldg., Chattanooga. Meeting annually with State Medical Society in April.

TEXAS

Texas Radiological Society.—President, C. F. Crain, M.D., Corpus Christi; *President-elect*, M. H. Glover, M.D., Wichita Falls; *First Vice-president*, G. D. Carlson, M.D., Dallas; *Second Vice-president*, P. E. Wigby, M.D., Dallas; *Secretary-Treasurer*, L. W. Baird, M.D., Scott and White Hospital, Temple. Meets annually. The next annual meeting is to be Jan. 18, 1941, in Sherman.

VERMONT

See New England Roentgen Ray Society.

VIRGINIA

Virginia Radiological Society.—President, Wright Clarkson, M.D., Petersburg· *Vice-president*, Clayton

W. Ely, M.D., Norfolk; *Secretary*, Charles H. Peterson, M.D., 603 Medical Arts Bldg., Roanoke.

WASHINGTON

Washington State Radiological Society.—President, George W. Cornett, M.D., Yakima; *Vice-President*, Frederick B. Exner, M.D., Seattle; *Secretary-Treasurer*, Kenneth J. Holtz, M.D., American Bank Bldg., Seattle. Meetings first Friday of each month at College Club, Seattle.

WISCONSIN

Milwaukee Roentgen Ray Society.—President, H. W. Hefke, M.D.; *Vice-president*, Frederick C. Christensen, M.D.; *Secretary-Treasurer*, Irving I. Cowan, M.D., Mount Sinai Hospital, Milwaukee. Meets monthly on first Friday at the University Club.

Radiological Section of the Wisconsin State Medical Society.—Secretary, Russel F. Wilson, M.D., Beloit Municipal Hospital, Beloit. Two-day annual meeting in May and one day in connection with annual meeting of State Medical Society, in September.

University of Wisconsin Radiological Conference.—Secretary, E. A. Pohle, M.D., 1300 University Ave., Madison, Wis. Meets every Thursday from 4 to 5 P.M., Room 301, Service Memorial Institute.

CANADA

Section on Radiology, Canadian Medical Association.—Chairman, Gordon Richards, M.D., Medical Arts Bldg., Toronto; *Secretary*, W. J. Cryderman M.D., Medical Arts Bldg., Toronto.

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La Société Canadienne-Française d'Electrologie et de Radiologie Médicales held a meeting at Quebec on Sept. 28, 1940, at which time the following officers were elected for the next two years: *President*, Albert Comtois, M.D., Hôpital Ste.-Justine, Montreal; *First Vice-president*, Jules Gosselin, M.D., Hôpital St.-Sacrement, Quebec; *Second Vice-president*, Paul Brodeur, M.D., General Hospital, Ottawa; *General Secretary*, Origène Dufresne, M.D., Institut du Radium, Montreal, and *General Treasurer*, Doriva Léonard, M.D., Hôpital Notre Dame, Montreal. Meetings are held the third Saturday of each month, generally at the Radium Institute, 4120 East Ontario Street, Montreal; sometimes, at homes of members.

CUBA

Sociedad de Radiología y Fisioterapía de Cuba.— Offices in Hospital Mercedes, Havana. Meetings are held monthly.

ABSTRACTS OF CURRENT LITERATURE

ABSTRACTS IN THIS ISSUE LISTED ALPHABETICALLY BY AUTHORS

ROENTGEN DIAGNOSIS

THE ABDOMEN

Differential Diagnosis of the Cause of Recurring Abdominal Pain in Infants and Children. R. R. Fitzgerald. Canad. M. A. J. **42**: 332–336, April, 1940.

Fitzgerald points to the increasing importance of appendicitis as a cause of death in Canadian children. Infants and children with recurring abdominal pain may be divided into two groups: (1) those that have had previous attacks, caused in all likelihood by the appendix, and (2) those with recurring abdominal pain caused by factors other than the appendix. According to the author, the sequence of events during an attack, *i.e.*, pain, vomiting, tenderness, fever, is the strongest support for a diagnosis of appendicitis. In such instances the appendix should be removed without unnecessary delay. Recurring abdominal pain in the second group may be caused by (1) developmental anomalies of the abdominal wall or of the urinary, genital, or intestinal tract; (2) a traumatic condition; (3) inflammations such as pancreatitis with mumps, osteomyelitis of the pelvis, non-specific mesenteric lymphadenitis, tuberculous lymphadenitis, chronic ulcerative colitis, and tuberculous peritonitis; (4) benign or malignant new growths; (5) special conditions, such as cysts, plumbism, worms, onset of menstruation, cyclic vomiting, oncoming rheumatic fever, chronic intussusception, megacolon.

According to the author, in attempting differential diagnosis one might refer to (1) the dextrocardia and repeated attacks of dyspnea in diaphragmatic hernia; (2) the great value of intravenous pyelography in urinary tract disease; (3) the shifting of the point of tenderness with altered posture in mesenteric lymphadenitis; (4) the use of the proctoscope in revealing ulcers in chronic colitis; (5) the use of a brief general anesthetic for palpation of the abdomen in search of tuberculous masses or malignant growths; (6) acetonuria at the onset of an attack of cyclic vomiting; (7) reliance on the x-ray for the diagnosis or its confirmation in many cases.

M. L. CONNELLY, M.D.

THE CHEST

The Etiology of Bronchiectasis. Eelco Huizinga. Acta Radiol. **21**: 75–100, February, 1940.

Huizinga examines the many factors which enter into the discussion of bronchiectasis. He is of the opinion that the disease is more frequently acquired than congenital, though a possible constitutional diathesis may play a part even in some of the undoubtedly acquired cases. As a direct cause, infections of early childhood are to be considered, especially pneumonia, pertussis, and measles. Aspiration of foreign bodies with bronchial obstruction and, in later years, bronchial tumors may be the cause. Sinus infection and bronchitis are also etiologic factors.

In a consecutive series of 100 bronchiectatic children the author found 23 per cent in the age group one and two years, 25 per cent from three to five years, and 52 per cent from six to thirteen years. Eighty per cent of these cases developed after pneumonia or pulmonary-bronchial infection; 20 per cent after aspiration of foreign bodies. In 18 per cent the disease was localized on the right side; in 52 per cent on the left side; in 30 per cent it was bilateral.

Bronchographic studies showed the marked influence of the respiratory movements on the bronchi, the enlargement of which was considerably more pronounced during inspiration than during expiration.

While so-called "acute bronchiectasis" following foreign body aspiration may heal completely, bronchiectasis due to shrinkage of interstitial tissue after pneumonia shows no healing tendency and, as a rule, becomes worse in the course of years.

Generally speaking, loss of elasticity of the bronchial wall due to inflammation and bronchial dilatation through radial traction (fibrous retraction and respiratory movements), occasionally complicated by "atelectatic collapse" of a portion of the lung, are the factors most frequently responsible for post-pneumonic acquired atelectasis of childhood.

ERNST A. SCHMIDT, M.D.

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Atypical Bronchopneumonia of Unknown Etiology. M. E. Murray, Jr. New England J. Med. **222**: 565–573, April 14, 1940.

Atypical pneumonia is the name given to those cases not showing complete pneumonic consolidation and lacking the usual severe clinical findings. They have been termed, also, "virus pneumonia" and "acute interstitial pneumonia."

Clinically, the patient may have had a cold for a few days, with headache, malaise, slight fever, a chilly feeling, and aches and pains. Examination shows little but an elevated temperature and a pulse rate lower than that which would be expected with the temperature.

Chest films frequently show consolidation several days before physical findings are positive. Usually an area of consolidation is seen extending out from the hilum, often toward the base, with the margin fading off to normal appearing lung. Consolidation in the cardiohepatic angle is an occasional finding and may easily be overlooked. The initial leukocyte count in the author's series usually ranged between 7,000 and 12,000. No etiologic agent was found, although numerous bacteria were isolated.

JOHN B. McANENY, M.D.

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Lung Abscess. Harold A. Kipp. Pennsylvania M.J. **43**: 1134–1136, May, 1940.

Lack of co-operation between the physician, bron-

choscopist, and surgeon has resulted in delayed treatment of the patient with a lung abscess, which is extremely hazardous. Roentgenologically, two characteristic features differentiate a bronchopneumonia from lung abscess, "namely, homogeneous veiling of the involved region of the lung and increase in the lung markings." Fluoroscopy and films in several diameters of the chest, the Potter-Bucky technic, and the laminograph are all mentioned as aids to diagnosis.

The author quotes Moore, who says that "20 to 50 per cent of all pulmonary abscesses recover without surgery," and that "the mortality in rupture of the putrid abscess into a clean pleural cavity compares favorably with that of rupture of a localized appendiceal abscess into the peritoneal cavity."

The technic of drainage and its complications are briefly discussed.

JOSEPH T. DANZER, M.D.

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Correlation of Post-mortem Chest Teleroentgenograms with Autopsy Findings, with Special Reference to Pulmonary Embolism and Infarction. Aubrey O. Hampton and Benjamin Castleman. Am. J. Roentgenol. **43:** 305–324, March, 1940.

Exact and detailed confirmation of the interpretation of roentgenograms of the chest is often difficult to obtain for three reasons: (1) Changes between the last roentgenogram and death cannot be ruled out. (2) Roentgenograms made just before death, usually being taken with a portable machine, may not show the lesion sharply and accurately. (3) Lungs are collapsed post mortem and accurate correlation with the air-distended lung on the roentgenogram is impossible.

A method for accurate comparison has, however, been devised. Just before autopsy the body is suspended vertically against a plate holder and a 7-foot chest examination made, with both anterior-posterior and lateral exposures. After their removal the lungs are fixed by a solution to prevent change in their size, then left in same solution for one week before study by the pathologist. Four hundred cases have been studied in this way.

The post-mortem roentgenogram of the chest taken by this method corresponds in general appearance to one taken ante mortem during quiet breathing or expiration. The diaphragm is usually about two interspaces higher than on an inspiration roentgenogram, the upper lobes are fairly well expanded, and the lower lobes are incompletely aerated. There is a reduction in the postero-anterior diameter of the chest. The blood vessels usually appear much smaller and less distinct, the aorta is about one-half the diameter, and the heart dilated or contracted.

In this report only pulmonary embolism and infarction are dealt with. Fourteen per cent of the cases studied showed this condition, a higher incidence than is generally accepted. The proportion is higher in medical than surgical cases. Pulmonary embolism may occur without infarction.

Infarcts are always peripheral in location and involve one or more pleural surfaces. During the first and probably the second day of infarction there is no definite destruction of alveolar walls but merely congestion of capillaries and diapedesis into dilated alveoli. The roentgen shadow usually does not develop before twelve hours and occasionally not before twenty-four hours after onset of symptoms, and the shadow is not sharply defined. After the second day necrosis follows. An infarct is sharp in outline and the roentgen shadow cast by it will also be sharp if it is projected through its greatest thickness. The shape is dependent entirely on the shape of the area of the lung involved. The long axis is always parallel to the longest pleural surface involved and the medial surface is of an irregular convex "hump" shape. The infarcts are not triangular with the apex toward the heart, as the text-book descriptions would lead one to believe. The apex, on the contrary, is directed away from the heart. A number of densities may be present with normal lung between them, thus differentiating the condition from carcinoma.

Only a small percentage of infarcts are accompanied by pleurisy. In the absence of active tuberculosis of the lungs and excluding apical adhesions, "dry" pleurisy or pleurisy with sterile effusion is more likely to be due to infarction than tuberculosis. Healed infarcts may be represented by scars or localized pleuritis.

Incomplete infarction is represented by a density of the lung which appears and disappears in two to four days and produces one or all of the symptoms of an infarct. The density is produced by edema and cellular deposits within the alveoli without wall destruction. The incomplete infarct is similar to the early stage of a true infarct, which would suggest that it is a beginning infarct that has aborted.

S. M. ATKINS, M.D.

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Apical Lung Tumors or So-called Superior Pulmonary Sulcus Tumors. Herman J. Moersch, H. Corwin Hinshaw, and Ira H. Wilson. Minnesota Med. **23:** 221–226, April, 1940.

Pancoast, in 1924, called attention to a group of apical lung tumors associated with pain referred to the shoulder and arm of the affected side, with certain cervical sympathetic phenomena which produced a train of symptoms and findings suggestive of tumor of the spinal cord.

In 1932 Pancoast applied the term "superior pulmonary sulcus tumor" to this symptom-complex and enumerated its essential features as follows: (1) homolateral pain around the shoulder and down the arm, (2) atrophy of the muscles of the arm and hand, (3) Horner's syndrome, (4) roentgenographic evidence of a small homogeneous shadow at the extreme apex of the lung, always with a variable amount of destruction of ribs locally and often vertebral infiltration. He came to the conclusion that this must be looked upon as a distinct clinical entity.

A ten-year review of the tumors answering this description occurring at the Mayo Clinic is presented.

The youngest patient was nineteen; the oldest seventy-two; 13 were males, 4 females. The left apex was the favorite site, the right being involved less than half as often. Early roentgen signs may be overlooked.

Pathologically, some of the cases were carcinoma of a bronchus; usually squamous-cell carcinoma, with some tissue unclassified as to type. Adenocarcinoma was found in other cases There was one case of chondroma. Others have reported metastatic lesions as producing the same syndrome. "Superior pulmonary sulcus tumor" is therefore not a justifiable term except when used to indicate simply that portion of the lesion limited to a distinct portion of a lung.

Most of the patients in the series reported were dead within six months of the initial examination.

PERCY J. DELANO, M.D.

Some Views on the Important Part Played by the Pressure Conditions in Chest and Abdomen for the Radiographic Examination of Heart and Lung. Gunnar Moberg. Acta Radiol. 21: 1–20, February, 1940.

The author investigated the considerable changes in the size of the heart and in the aspect of the lung fields as they are occasionally seen in routine x-ray examination of apparently normal persons. Basing his conclusions on observations made by means of Valsalva's experiment, Moberg attributes the phenomenon to volumetric variations of the blood distribution, due to involuntary thoracic and abdominal pressure changes.

ERNST A. SCHMIDT, M.D.

Radiological and Clinical Study of Aortic Aneurysm. G. Friedlaender. Brit. J. Radiol. 13: 109–122, April, 1940.

Illustrative films and the histories of 18 cases of syphilitic aortic aneurysm are given. Contrary to the generally held opinion, the duration of life is quite long. Only one patient died a year after diagnosis. The remainder lived from three to twenty years. Antisyphilitic treatment had no effect upon the aneurysm.

In only a small percentage of cases is death due to rupture. The majority of patients die of coronary disease or congestive heart failure. An increase in the size of the aneurysm does not correspond to the deterioration in the patient's condition. The presence of wide-spread syphilitic aortitis makes the prognosis unfavorable.

SYDNEY J. HAWLEY, M.D.

Engorgement of the Pulmonary Veins by Extension of Cardiac Enlargement Posteriorly: Relation to Postural Dyspnea in Cardiac Patients. W. D. Reid. New England J. Med. 222: 627–634, April 11, 1940.

Since the cause of pulmonary vein engorgement has never been satisfactorily settled, this article is presented to sustain the theory of direct pressure on the pulmonary veins by the cardiac enlargement posteriorly.

The theory is supported by the fact of the posterior position of the pulmonary veins; the tendency to obliteration of the posterior mediastinal space by an enlarged heart producing signs of pulmonary engorgement; the similarity of clinical appearances between cardiac compression of the posterior mediastinum and tumors in this region.

A series of 17 patients with postural dyspnea and 36 without were examined fluoroscopically. In all the patients with dyspnea there was marked encroachment on the retrocardiac space; in only one of the non-dyspneic patients was there similar cardiac encroachment.

JOHN B. MCANENY, M.D.

The Thymus Question. James B. Butchart. Pennsylvania M.J. 43: 962–965, April, 1940.

The diagnosis of hypertrophy of the thymus is not easy, as we have very few standards from which to judge. The author quotes Boyd, who found that at necropsy a thymus weighed within normal limits when death occurred within twenty-four hours of the beginning of an illness, and that its weight decreased considerably if the illness continued over a week. This was not true in cases of goiter and lymphatic leukemia.

Detailed study of x-ray findings by various authors shows that a positive diagnosis of enlarged thymus can seldom be made.

Follow-up studies on children that had been x-rayed for thymus enlargement showed a high percentage of urticaria, eczema, asthma, and hay fever in later life.

The author speculates as to whether or not the amelioration of symptoms after irradiation is due to its non-specific effect on bronchial asthma.

JOSEPH T. DANZER, M.D.

THE ESOPHAGUS

Spontaneous Rupture of the Œsophagus. P. C Mallam, H. A. B. Whitelocke, and A. H. T. Robb-Smith. Brit. J. Surg. 27: 794–796, April, 1940.

Since the condition was first described by Boerhaave in 1724, there have been only 40 cases published of spontaneous rupture of the esophagus. The authors' case was in a man aged forty-four with an essentially negative past history and acute sudden onset. A laparotomy was performed for suspected perforated viscus and nothing was found except a slight amount of free peritoneal fluid. The patient died twelve hours after the onset of symptoms. The post-mortem examination showed an extreme degree of emphysema of the subcutaneous tissue of the face, neck, and chest. In both pleural cavities were effusions of brownish fluid smelling of gastric contents. Examination of the esophagus revealed a longitudinal linear tear through all the coats. It was 6 cm. long and lay to the left of the midline, 4 cm. above the cardia. Sections of the esophagus showed no scarring or pathological process.

The diagnosis of ruptured esophagus is rarely made during life. Surgical emphysema beginning around the neck and spreading over the chest, face, and limbs is a fairly constant feature. Bilateral hydrothorax, more marked on the right, is another diagnostic sign. Aspiration of the chest will reveal the presence of acrid fluid containing food particles and having the characteristics of gastric juice. MAX CLIMAN, M.D.

FOREIGN BODIES

Operation on Roentgenologically Demonstrated Foreign Bodies. Th. Johner. Schweiz. med. Wchnschr. **70**: 140–142, Feb. 17, 1940.

The author advocates the insertion of needles at right angles in the vicinity of foreign bodies, roentgenography to locate the foreign body with respect to the needles, in two planes, and subsequent removal. He reports two cases in which this method was successfully used.

LEWIS G. JACOBS, M.D.

Radiographic Mensuration and Localization. A New Method. J. P. Hederman. Brit. J. Radiol. **13**: 123–126, April, 1940.

The author describes a simple and ingenious method of pelvic measurement and localization of foreign bodies. A special caliper is used, having an additional short arm, which is slotted to receive a set screw on one of the long arms. The short arm and one long arm can be firmly screwed together; at the same time the other long arm may be placed in position, removed, and replaced again accurately.

Radiographs are made with the caliper ends located at the ends of appropriate diameters, either of the pelvis or.passing through the foreign body. The distance between the two caliper ends and the diameter to be determined are measured on the roentgenogram. After the calipers have been removed from the patient, the arms are replaced in the same position by adjustment of the third arm, and the *actual* distance between the tips is measured. By simple proportion the true diameter of the pelvis or the depth of the foreign body can then be quickly and accurately calculated.

SYDNEY J. HAWLEY, M.D.

THE GASTRO-INTESTINAL TRACT

Normal Variation in the Gastrointestinal Response of Healthy Children. Icie G. Macy, Lawrence Reynolds, Helen J. Souders, and Mary Bates Olson. Am. J. Roentgenol. **43**: 394–403, March, 1940.

Serial roentgenographic studies of the gastro-intestinal response of seven children between the ages of 74 and 117 months to test meals composed of 2 ounces of barium sulfate in 4 ounces of water and in 4 ounces of milk, ingested at body temperature, produced evidence that the variation among different individuals, though wide, is not as great as the variation produced by the different types of media used.

From the 174 roentgenograms of the gastro-intestinal tract of this group of specially controlled children the mean gastric emptying time in response to the water-barium meal was found to be 1.9 hours (range from 1.0 to 2.8) and for the milk-barium meal 3.1 hours (range from 1.5 to 4.5). The usual emptying time of the stomach is considered to vary from three to six hours, depending upon the emotional state, character of food, and other factors.

In all cases except one, the water-barium meal entered the jejunum during the first twelve minutes after its ingestion. The emptying time of the jejunum with the milk-barium meal was 3.4 hours in contrast to 2.4 hours with the water-barium meal.

There were no consistent significant differences in the emptying of the colon as shown in the roentgenograms made twenty-four, forty-eight, and seventy-two hours after the ingestion of the meals, indicating that any compensation or adjustment to the emptying time of the stomach must take place in the small intestine within the first twenty-four hours.

Milk stimulated considerably more tone and vigorous peristalsis with churning effect in the stomach and a prolonged emptying time. Furthermore, milk caused a delay in the passage of the barium through the intestinal loops, particularly in the ileal portions. There were great variations in response of the individual subjects to the milk-barium meal after an interval of eighteen months, due perhaps to physiological changes coincident with growth, or to shorter preparation, and therefore less complete standardization of the subjects.

S. M. ATKINS, M.D.

Significance of Melæna in Children. Harold Little. Canad. M.A.J. **41**: 575–580, December, 1939.

In 8 cases presented Little stresses the significance of blood in the stool for early diagnosis. The color, consistency, and amount of blood, its relation to the feces, and the consistency of the stools are of definite significance. Slight tears of the rectal mucosa, anal fissures, prolapse of the rectum, rectal polypi, and hemorrhoids are simple causes of melena. Inflammation of the intestinal mucosa is recognized by the typical appearance of the stool, in which mucus, pus, bile, feces, and blood appear mixed. Absence of clotting elements in the blood stream may cause copious intestinal hemorrhage, as in hemorrhagica neonatorum. Melena is usually present in certain blood dyscrasias, as in thrombocytopenic purpura, with bleeding points in the mucous membrane of the upper respiratory tract or in the skin. Melena due to intestinal obstruction is for the most part caused by acute intussusception.

Intestinal hemorrhage is commonly associated with Meckel's diverticulum. From post-mortem statistics and from observations at laparotomy, this has been estimated to be present in about 2 per cent of people, predominantly in males. In the majority of cases the symptoms appear before puberty, in many during the first year of life. This anomaly may give rise to different groups of symptoms according to the conditions present in the diverticulum. The usual classification is as follows: (1) ulceration of the mucosa of the diverticulum, (*a*) without perforation but with hemorrhage, (*b*) with perforation with or without hemorrhage; (2) the starting point and possibly the cause of an intussusception; (3) acute inflammation in the diverticulum; (4) obstruction other than intussusception.

In the 5 cases of Meckel's diverticulum in infants presented here, hemorrhage was a constant finding. In 4 gastric mucosa was present in the diverticulum, in 1 aberrant pancreatic tissue. Intussusception oc-

curred twice. Hemorrhage occurred in 2 cases of intussusception in older children. The intussusception in one case was at the ileo-cecal junction, in the other within the sigmoid colon. Symptoms of thrombocytopenic purpura in a four-year-old boy are described.

<div align="right">M. L. CONNELLY, M.D.</div>

Peptic Ulcer. Editorial by H.E.M. Canad. M. A.J. **42:** 177–178, February, 1940.

This editorial draws attention to the interesting contribution of G. Alsted of Copenhagen on the frequency of incidence and the anatomical position of peptic ulcer (Studies on the Changing Incidence of Peptic Ulcer of the Stomach and Duodenum, Ejnar Munksgaard, Copenhagen; Oxford Univ. Press, London, 1938).

Duodenal ulcer was rarely mentioned in the early accounts and little information was obtainable as to the absolute frequency of peptic ulcer. Study of a large number of post-mortem reports reveals that during the last hundred years at least 5 per cent of the population suffered from peptic ulcer at some time of their lives. The supposed increase in frequency of ulcer is due to improved diagnostic technic and a growing number of readmissions. The proportion of incidence of ulcer has gradually shifted from 1:6 to 3:1, male to female.

Evidence seems to support the view that hemorrhage is more frequent now than in the last century. It is believed that peptic ulcers have largely shifted from the body of the stomach to the duodenum and that they have become more chronic in type. This apparently accounts for the greater number of admissions and the growing frequency of hemorrhage.

<div align="right">M. L. CONNELLY, M.D.</div>

Acute Mechanical Obstruction of the Small Bowel. L. S. McKittrick and S. P. Sarris. New England J. Med. **222:** 611–622, April 11, 1940.

At intervals reviews of cases of acute intestinal obstruction of the small bowel operated upon at the Massachusetts General Hospital have been made. This study covers the period from 1932, when suction decompression of the bowel became a common practice, and an attempt is made to clarify the indications for early operative as against non-operative treatment.

Eighty per cent of the patients in this series of 136 cases had previous laparotomies. The symptoms include sudden severe abdominal pain, often colicky, later becoming steady. Vomiting occurs frequently and may become fecal in character. Obstipation is usually present. Distention is of late occurrence, and tenderness may be absent. Obstructive peristalsis, characterized by periodic high-pitched "tinkles," is often found.

Of laboratory studies, the x-ray film of the abdomen is the most important single agent. It was diagnostic in 90 per cent of the series and in the remaining cases was suggestive.

This study suggests the great importance of history and physical examination and an x-ray film of the abdomen. Early diagnosis is of utmost need. Dehydration and chemical imbalance must be corrected. Decompression has its place, but operation must not be neglected.

<div align="right">JOHN B. McANENY, M.D.</div>

Roentgen Diagnosis of Ileus. Erik de Fine Licht. Acta Radiol. **21:** 32–37, February, 1940.

While, according to the author, the mere accumulation of gas in the small intestines is insufficient for the roentgen diagnosis of ileus, the presence of intestinal fluid levels is considered to be of considerable diagnostic importance. From the point of view of prognosis and operative indications, the value of a single x-ray examination is doubtful; for the decision of these questions, repeated examinations are necessary. Except in cases of colonic obstruction, where a barium enema may help in the differential diagnosis, the x-ray examination cannot determine with certainty whether the ileus is paralytic or mechanical. Pictures similar to those observed in ileus are occasionally seen after abdominal operations or trauma.

<div align="right">ERNST A. SCHMIDT, M.D.</div>

Management of Postoperative Intestinal Obstruction Complicated by Hemorrhage on the Basis of Prothrombin Deficiency. Claude F. Dixon and Robert O. Gregg. Minnesota Med. **23:** 169–173, March, 1940.

A case is described in which malignant change was found in a polyp of the colon in a patient seven years of age. Rectal bleeding had been observed since the age of three months. Rectal polyps were seen proctoscopically. Others were found by double contrast enema.

Operation showed malignant change in one polyp. On the sixth postoperative day high obstruction developed, the output by nasal suction rising to 3450 c.c. on the ninth day. This was relieved by the passage of a Miller-Abbott tube, with drainage of the jejunum. The obstruction recurred, with passage of blood per rectum. The Quick prothrombin time measured two minutes and twenty-one seconds. A transfusion of 500 c.c. of citrated blood was given. Laparotomy was resorted to, and an enteric stoma of the Witzel type was formed.

On the day of operation, after 750 c.c. of blood had been given, the prothrombin time had fallen to forty-four seconds. Capsules of vitamin K were given that day through the original enterostomy tube, but had to be discontinued because of cramp-like pain. Vitamin K was then introduced through the nasal tube. Two c.c. of Klotogen and 6 gm. of bile salts were also given by nasal tube; 500 c.c of citrated blood was given in the twenty-four hours following operation. By the end of that period all bleeding had ceased, the Quick prothrombin time had fallen to twenty-four seconds and the Smith qualitative test revealed 51 per cent normal concentration of prothrombin in the blood. Two c.c. of Klotogen with bile salts were administered on each of four successive days, and further therapy with vitamin K was carried out.

During the period of obstruction the patient was also given 25 mg. of betaxin, representing 8,300 units of vitamin B and 4 c.c. of cevitamic acid (400 mg.) by vein. Recovery was satisfactory.

Rectal polyps had apparently been present since the age of three months. Unmistakable evidence of early malignant transformation was found in a group of glands in a large polyp in the transverse colon.

<div align="right">PERCY J. DELANO, M.D.</div>

Volvulus of the Cecum: A Postoperative Complication. Claude F. Dixon and Joseph M. Miller. Minnesota Med. **23:** 250–251, April, 1940.

Volvulus may occur in the ileocecal region as well as in the sigmoid. The accident occurs more often when a long mesentery is present. When the cecum, ascending colon, and part of the transverse colon, are found to have a mesentery in common with the small bowel, the rotation is usually counter-clockwise. When more development is present, the rotation is clockwise. Pain of a cramp-like type, rather severe in nature, and tending to be localized, is present. Early tenderness, constipation, occasional shock, and rapid localized distention are found.

Chalfont collected 118 cases. All the patients who were not operated upon died. Of the 96 who were operated upon, 57 or 59 per cent died. The total mortality, operative and non-operative, was thus 67 per cent. These figures apply to all cases of volvulus of the sigmoid, most of which occurred primarily.

Only two cases of volvulus of the cecum following operation have been found in the literature. These two patients, as well as those of the author, recovered following surgical intervention.

<div align="right">PERCY J. DELANO, M.D.</div>

THE GENITO-URINARY TRACT

Lateral Pyelography. E. L. Shiflett and D. Y Keith. Am. J. Roentgenol. **43:** 664–672, May, 1940.

Five years' experience with lateral pyelography has shown this procedure to be of definite value as an aid to the study of pathologic behavior. With a simple technic and Mertz's criteria of the normal lateral pyelogram, localization of tumors has been made more exact. Helpful and at times conclusive information has been obtained in cases of renal neoplasms and cysts, perinephric abscess, primary retroperitoneal tumors, retroperitoneal infections, tumors arising from organs adjacent to the kidney, retroperitoneal metastatic malignant growths, congenital and acquired anomalies of kidney and ureter, and a large group of less common conditions found in the urinary tract. The normal variable in the urinary system is much less than in the average system, thus making it relatively easy to detect pathology.

The lateral pyelogram is not recommended as a routine procedure, but it is frequently indicated and sometimes essential.

<div align="right">S. M. ATKINS, M.D.</div>

Anomalies of the Urinary Tract. Wm. J. Baker. Am. J. Roentgenol. **43:** 636–648, May, 1940.

Over 40 per cent of renal and ureteral pathology is due to developmental anomalies. The x-ray has made diagnosis of these anomalies a common occurrence. Practically all anomalous possibilities are explained by the embryology of the urinary tract.

(1) Congenital absence of one kidney is the most important anomaly of number. At times, cystoscopy will show normal ureteral orifices, with one ureter ending in a blind stump on the side of the absent kidney.

Double kidneys may occur on one or both sides. The upper is usually the smaller of the two kidneys, and the seat of more pronounced pathology. A carnation-shaped pelvis usually indicates a double kidney.

(2) In the presence of a true hypoplastic kidney, symptoms may all point to the normal but hypertrophied kidney on the opposite side.

(3) Anomalies of form include cysts, solid tumors, pyelitis, fused kidneys.

(4) For the diagnosis of ptotic kidneys, urograms must be made in the flat and upright positions. In rare cases, urograms of a kidney displaced by an aneurysm of the renal artery may be interpreted as showing a renal tumor.

(5) Incomplete rotation of the kidney can be diagnosed only by x-ray. It may lead to infection or stone, due to poor drainage.

(6) Anomalies of the calices, pelvis, and ureters are common. Occasionally duplicated ureters may drain the major calices directly, in the absence of pelves. At times a stricture occurs where the ureters branch.

For embryological reasons, when ureteral duplication is complete to make two vesical ureteral orifices on one side, the distal orifice leads to the upper pole of the kidney, and the proximal orifice to the lower pole.

Among anomalies of size of the ureter is ureterocele, which is a cystic dilatation of the lower end of the ureter, with but little or no dilatation of the renal pelvis.

7. Aberrant vessels always present the possibility of ureteral obstruction.

8. Urachal cysts may cause constant discharge from the navel, without having any connection with the bladder. Congenital urethral valves or contractures of the vesical neck frequently result in marked bilateral pyelo-ureterectasis.

<div align="right">S. M. ATKINS, M.D.</div>

Malignant Tumors of the Kidney in Adults. Carl L. Gillies, Am. J. Roentgenol. **43:** 629–635, May, 1940.

Malignant tumors of the kidney fall mainly into two groups: those arising from the pelvis and those from within the kidney, the so-called hypernephroma or renal-cell carcinoma. The present paper is based on 50 cases.

Five malignant tumors of the pelvis were present in this series. Hematuria was the first symptom in each, intermittent in character and present six months to five years before the patient was first seen. All pa-

tients had clots at some time and moderate secondary anemia. Dull aching pain in the flank, colic, and palpable tumor were variable. Kidney stones were found in one and bladder implants in three.

In the presence of small papillary tumors the pyelogram showed irregular filling defects without distortion of the uninvolved portion of the pelvis or kidney outline. Whether the lesion was malignant or benign could not be determined. Blood clots tend to be smooth in outline. Large papillary tumors distort the pelvis and may cause hydronephrosis; the kidney outline is intact unless invasion of the parenchyma has occurred.

Forty-five patients in the author's series had malignant tumors arising within the kidney: 33 males and 12 females, ranging in age from thirty-three to seventy-six years. The duration of symptoms varied greatly; in a few these dated back fifteen years. The first symptoms varied: hematuria in 53 per cent, pain in 13 per cent, tumor in 13 per cent, loss of weight and weakness in 9 per cent. In 4.5 per cent the earliest symptoms were referable to metastases. Seven per cent were symptomless. Most patients had more than one symptom.

Roentgen examination revealed calcium deposits in 38 per cent. Compression and elongation of one or more of the major calices were frequently seen. Less common are complete loss of normal pelvic landmarks and dilatation of the pelvis accompanied by elongation and dilatation of the calices without remarkable compression.

S. M. ATKINS, M.D.

A Solitary Intrarenal Cyst. Max Lüdin and R. Howald. Schweiz. med. Wchnschr. **70:** 230–232, March 16, 1940.

A man referred for backache was found, on roentgen examination of the spine, to have a round, dense concretion in the region of the left kidney. Pyelograms showed that this lay medially and above the pelvis, and was not connected with it. At operation a solitary cyst containing yellowish grumous material was discovered and excised. The contents were found by chemical analysis to be calcium phosphate and carbonate concretion. The cyst was shown by microscopic study to lie in almost normal kidney substance and to be lined with epithelium.

The difficult differential diagnosis, and the fact that a calculus was originally suspected, led to the report. Excellent illustrations are shown.

LEWIS G. JACOBS, M.D.

THE OSSEOUS SYSTEM

The Diagnosis of Joint Injuries. J. C. Flood. British Med. Jour. **1:** 689–690, Feb. 27, 1940.

This article is of great interest for the reason that the reader immediately suspects a great variance between the course the author advises in diagnosing joint injuries and that which is the usual course among practitioners in general. His rules are as follows:

(1) See if all movements of the joint are limited.
(2) If any one movement is free, the pathology is external.
(3) Note effect of stretching ligaments which may be injured.
(4) Palpate peri-articular structures for tenderness.
(5) Palpate bony prominences for possible injury.
(6) Finally, have roentgenograms made.

The reasons given by the author for this last procedure are, first to confirm the clinical diagnosis, second to avoid missing a fracture, and, finally, to circumvent trouble in the courts.

One is forced to suspect that in most up-to-date clinics Rules 1 to 5 are followed very cursorily and Rule 6 is first and foremost.

Q. B. CORAY, M.D.

Errors in Roentgen Diagnosis. Part I.—Pseudofracture. George L. Sackett. Ohio State Med. Jour. **36:** 137–144, February, 1940.

The author reviews the standard groups of easily misinterpreted bony structures and presents typical cases of each. The vascular, suture, and epiphyseal lines and their usual confusing anomalies are presented. Various types of superimposed soft-tissue shadows are discussed, as are artefacts. The author stresses the importance of: (1) proper technical factors in taking films; (2) at least two views; (3) stereoscopic views where indicated; (4) comparison study of the opposite extremity in case of suspected anomaly.

SIMON POLLACK, M.D.

Fractures of the Carpal Scaphoid. A. Thorndike, Jr., and W. C. Garrey. New England J. Med. **222:** 827–830, May 16, 1940.

In a period of five years the authors observed 17 cases of fractured carpal scaphoid, 11 of which were old or unrecognized. These fractures are quite common in athletes. Frequently it is impossible to demonstrate the fracture immediately after the injury, but the separation appears later when absorption occurs as the result of motion. It is a good practice to subject all painful wrists to x-ray examination at weekly intervals.

For the demonstration of a fractured scaphoid it is suggested that the clenched fist be placed on the film with the fingers down and the hand in extreme ulnar deviation and with full pronation.

Union may be expected in a high percentage of cases if the hand is immobilized in slight radial deviation and 40 to 50 degrees extension. Excision of the fragments is becoming a less frequent procedure.

JOHN B. McANENY, M.D.

Fracture of a Sesamoid of the Thumb. S. E. Sinberg. J. Bone & Joint Surg. **22:** 444–445, April, 1940.

The rarity of fracture of the sesamoid bones prompted

the report of this case. The diagnosis is often difficult because of confusion with a bipartite sesamoid, which may also be injured. The differentiation can be made by recognition of the irregular fracture line, absorption along the fracture line, and subsequent evidence of healing.

<div align="right">JOHN B. MCANENY, M.D.</div>

March Fracture—Pied Forcé. F. A. R. Stammers. British Med. Jour. 1: 295–296, Feb. 24, 1940.

This article is an account of a linear fracture of the neck of the third metatarsal bone, supposedly brought on by the rigors of army drill and not associated with any direct trauma.

In the first case described the patient was the author himself. His symptoms were sudden pain in the dorsum of the foot, with localized tenderness progressing shortly to total incapacitation of the foot on that side. X-ray examinations, at first negative, later showed a ring of callus about the neck of the third metatarsal. Two other similar cases are described.

<div align="right">Q. B. CORAY, M.D.</div>

Deformity of First Metatarsal Head Due to Faulty Foot Mechanics. L. F. Miller and J. Arendt. J. Bone & Joint Surg. 22: 349–353, April, 1940.

The authors describe three cases of deformity of the first metatarsal head, which they believe to be due to trauma, followed by an aseptic necrosis of the head of the first metatarsal, resulting in loss of joint space and deformity of the head.

The trauma is attributed to the loss of proper function of the sesamoids, which are posterior and lateral to their normal position, thus permitting the strain of weight-bearing to fall upon the first metatarsal head. Elongation of the first metatarsal results in the same relative displacement of the sesamoids.

This change in relationship soon produces changes seen in aseptic necrosis elsewhere. There are the minute infarct, subcapital osteochondritis, and collapse of the articulating surface.

<div align="right">JOHN B. MCANENY, M.D.</div>

A Common Anatomical Variation in the Sacro-iliac Region. M. Trotter. J. Bone & Joint Surg. 22: 293–299, April, 1940.

This is a description of a variation in the anatomical structure of the sacro-iliac articulation. It is really an added feature to the commonly understood sacro-iliac joint, in which part of the ilium extends posteriorly upon the sacrum and forms a small articulating surface, about 8 to 10 mm. in diameter. It is situated at the level of the first or second sacral foramen, and may be single, double, unilateral, or bilateral.

This accessory articulation has been demonstrated in x-ray films, but probably could be shown more frequently if it were more widely known and looked for in examinations of the sacro-iliac joints.

<div align="right">JOHN B. MCANENY, M.D.</div>

Osteo-arthritis of the Hip. L. W. Plews. Brit. J. Surg. 27: 682–695, April, 1940.

The author studied 242 cases of osteo-arthritis of the hip, using an additional 100 cases picked at random and with no complaint in the hip as controls. In 66 cases trauma was a definite etiologic factor. Adolescent coxa vara, or slipped epiphysis, accounted for 15 cases and protrusio acetabuli for 12 cases. In all of the latter the medial wall to the acetabulum was thin, whereas in other cases it is thickened. In the cases produced by slipped epiphysis it was found that the earlier the age at which slipping occurred the later was the onset of osteo-arthritis. The average age at onset was thirty-two years.

There were 7 undoubted examples arising from Perthes' disease. Septic arthritis, congenital dislocation of the hip, deformity of the acetabulum and Paget's disease were etiologic factors in a small number of cases. In 116 cases the etiologic factor was unknown. Twenty patients had no complaint either in the past or at the time of examination.

Three cardinal roentgenographic signs are considered necessary for the diagnosis: (1) loss of joint space; (2) subchondral bone sclerosis; (3) the presence of osteophytes. Cases characterized by much new bone formation were not as painful as those in which new bone formation was minimal. New bone formation on the lateral aspect of the acetabular floor was found in the majority of cases, a process that can be demonstrated in serial roentgenograms.

Conservative treatment, with the aim of resting the joint, frequently results in considerable, though perhaps temporary, improvement. Physiotherapy afforded only transient benefit, whereas the results of deep x-ray therapy were encouraging. Operative measures include arthrodesis and excision of the femoral head and neck.

<div align="right">MAX CLIMAN, M.D.</div>

The Distribution and Treatment of Extra-Articular Foci in Tuberculous Arthritis of the Hip-Joint. J. A. Cholmeley. Brit. J. Surg. 27: 224–233, October, 1939.

The author reviewed 55 cases of extra-articular tuberculous disease of the hip during the decade 1927–1937. The patients were all children, the average age being 5.4 years, the maximum 13 years and the minimum 9 months. The commonest focus was in the medial half of the acetabular roof (19 cases) and the next most common in the femoral neck (17 cases). Twelve cases were treated by excision or curettage of the bony focus followed by the usual conservative treatment; in the remaining 43 cases purely conservative measures were employed. In 40 of the 43 cases treated conservatively, involvement of the hip joint occurred; in 3 cases only did the joint remain free from disease. Of the 12 cases in which the extra-articular focus was excised, involvement of the hip joint occurred in 11. It is thus apparent that the joint is almost invariably involved sooner or later. One reason for failure of operative intervention is believed to be

the presence of multiple foci not always demonstrable roentgenographically. Involvement of the joint may occur after as long an interval as two years, however efficient the treatment. Less than 10 per cent of children with extra-articular tuberculous disease of the hip recover with an intact hip joint.

MAX CLIMAN, M.D.

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Osteochondritis Dissecans of the Hip. D. King and W. Richards. J. Bone & Joint Surg. 22: 327–348, April, 1940.

Osteochondritis dissecans is a non-infectious aseptic necrosis of a segment of subchondral bone. The lesion is most frequently found in the knee and elbow, but its occurrence in the hip has also been reported. In the hip, the lesion usually occurs between the ages of sixteen and thirty-two, mostly in males, and the etiology is unknown.

Symptomatology is divided into three stages; first, latent, with limitation of motion due to muscle spasm; second, painful, with progressive pain, fatigue, and "pseudo-locking" due to muscle spasm; third, ankylosing, in which arthritic changes predominate.

Roentgenographically osteochondritis dissecans of the hip typically shows a sequestrum, usually on the superolateral aspect of the femoral head. It is sharply defined, punched-out, with well-marked borders, and is more dense than the normal bone. The focus is from 2 to 9 mm. thick, and its rim is sharp, clear, and has a double contour. The rest of the femoral head is normal. As progress occurs, the head and acetabulum show arthritic changes, to the extent of malum coxae senilis.

Both hips should be examined because of the frequency of bilaterality.

Two case reports are included in this article, together with suggestions for treatment. Several good roentgenographs are reproduced.

JOHN B. McANENY, M.D.

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Osteochondritis Dissecans of a Metatarsal Head. B. Carrell and H. M. Childress. J. Bone & Joint Surg. 22: 442–443, April, 1940.

A case is reported of osteochondritis dissecans of a first metatarsal head, proved by operative removal of the loose body and discovery of a corresponding defect in the joint surface of the bone. The free body was first thought to be part of a broken needle, but later roentgenograms showed that it was osseous in nature. The loose body was removed surgically with complete recovery and relief of symptoms.

JOHN B. McANENY, M.D.

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Case of Osteogenesis Imperfecta Tarda with Platyspondylisis. Göran Zander. Acta Radiol. 21: 53–61, February, 1940.

A case of osteogenesis imperfecta tarda was observed in an eight-year-old boy whose development had been normal up to the age of twelve months. Since that

time he had suffered a total of 23 fractures. From the age of three years, he had diabetes and was treated with insulin. There was no history of malformations in the family.

Roentgenologically there was seen a general halisteresis of all visualized bones with evidence of numerous old fractures and bowing of extremities. An outstanding feature was the biconcavity of all vertebral bodies, which apparently was progressive as demonstrated by a later examination. The vertebral bodies formed thin biconcave plates 0.5 to 1.0 cm. in height, while the diameters of the markedly convex intervertebral discs ranged from 1.5 to 2.0 cm.

ERNST A. SCHMIDT, M.D.

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Polyostotic Fibrous Dysplasia. Torfinn Denstad Acta Radiol. 21: 143–150, April, 1940.

Denstad reports the case of a young woman, eighteen and a half years old, with pathologic fracture of the shaft of the left femur and extensive bone rarefaction and cortical thinning in the left femur, tibia, and fibula. The postoperative microscopic diagnosis was "osteitis fibrosa" (benign giant-cell tumor). The author, however, doubts the correctness of this diagnosis and thinks that the lesions are due to the less known pathological entity, "polyostotic fibrous dysplasia." The differential diagnosis of polyostotic fibrous dysplasia on the one hand and bone cyst, giant-cell tumor, and hyperthyroidism on the other is discussed in detail. The absence of adenoma of the parathyroids is significant since it results in failure of parathyroid operations The blood calcium values are either normal or only negligibly elevated. The main treatment consists in prophylaxis against fracture. The therapeutic effect of bone curettage or bone implantation is doubtful. The activity of the lesion decreases with progressing years but the bone structure fails to return to normal.

ERNST A. SCHMIDT, M.D.

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Diagnosis and Roentgen Treatment of Certain Forms of Lumbago. Chr. I. Baastrup. Acta Radiol. 21: 151–163, April, 1940.

In cases of increased lordosis due to a number of pathologic conditions (tuberculosis, Paget's disease, fluorosis, spondylosis deformans, congenital abnormalities, and old age changes) a certain form of inter spinal osteoarthrosis may develop which the author terms "spinous process lumbago." The pressure of one spinous process on another results in destruction of the interspinous tissue and osteoarthritic alteration of the spinous processes. The clinical symptoms are acute and chronic pain and protracted muscular contractions. About 75 per cent of the cases showed improvement following x-ray therapy. As a rule, three single doses of 300 r each were given at intervals of six weeks. The largest total dose applied was 9×300 r, distributed over a period of four years.

ERNST A. SCHMIDT, M.D.

A Case of Unilateral Neosacralization of the Lumbar Spine. Leopoldo Bresci. Radiol. Med. **27**: 121–124, February, 1940.

The author states that a review of the literature reveals that only three cases of neosacralization of the lumbar spine have been previously reported. The one reported herein occurred in a 51-year-old man who had suffered a severe trauma of this region 21 years previously. Roentgenogram showed, beside the bone plates supposedly of new formation with the corresponding synarthrosis, old ununited fractures of the second and third right transverse processes.

Hypotheses of pathogenesis are offered. Congenital malformation as well as the deposit of new bone following trauma is considered. The latter hypothesis is accepted as true in the case reported.

ANTONIO A. MAYORAL, M.D.

Intraspinal Protrusions of the Intervertebral Discs; Roentgenographic Findings. Kenneth S. Davis. California & West. Med. **51**: 230–234, October, 1939.

This is an excellent discussion on the interesting problem of protrusion of the intervertebral discs, illustrated by several roentgenograms. The author discusses the narrow intervertebral joint space, hypertrophic changes in the spine, compression fractures, air and lipiodol myelography, outlining the technic and describing the normal and abnormal findings. Differential diagnosis is also considered. The paper is followed by several interesting discussions by other physicians.

JAMES J. CLARK, M.D.

A Review of Cases of Injury to the Vertebræ Occurring in the Royal Air Force. Philip A. Hall and George H. Morley. British Med. Jour. **1**: 159–163, Feb. 3, 1940.

The authors open their article with the comment that the great majority of injured vertebræ cases existing in the air force are not due directly to flying but rather to activities on the ground or associated with training. However, the crushed vertebra is always a subject of importance to roentgenologists.

Fifty-seven cases of injury to the vertebral column are reviewed and the treatment and conditions are described. The author states that early reduction by hyperextension and adequate fixation is the primary rule in handling such cases; there are, however, exceptions. When there are dislocation and displacement of the articular process, reduction must be accomplished first, if necessary, by surgery. If this is not done, the cord may be unduly stretched, with consequent increased disability resulting therefrom. Paralysis is no contra-indication to this procedure but rather a strong indication. Laminectomy has practically disappeared from the treatment of fractured vertebræ, for the reason that it is seldom necessary nor is it likely that any improvement in the patient's condition results therefrom. It would appear that all possible results may be accomplished by the simple methods of reduction and hyperextension.

Q. B. CORAY, M.D.

Subperiosteal Giant-Cell Tumor. W. J. Potts. J. Bone & Joint Surg. **22**: 417–420, April, 1940.

Potts records the history of a six-year-old boy who developed a swelling at the angle of his right jaw, first thought to be mumps, but later determined to be a new growth. At operation this was found to be a giant-cell tumor.

This is believed to be the first reported example of subperiosteal giant-cell tumor of the skull or jaw.

JOHN B. MCANENY, M.D.

Giant-cell Tumors of the Patella. Victor Richards, A. F. Giberson, and Don King. West. Jour. Surg. **48**: 47–49, January, 1940.

A case of giant-cell tumor of the patella with pathologic fracture is presented and 16 other cases gathered from the literature are reported. The patient was a 24-year-old male. Complete excision and plastic repair were done, with no recurrence to date.

SIMON POLLACK, M.D.

Bone Destruction in Carcinoma of the Uterine Cervix, by Direct Propagation or by Lymphogenic or Hematogenic Metastasis. Flemming Norgaard. Acta Radiol. **21**: 221–229, April, 1940.

Bone metastases in the pelvis following carcinoma of the uterine cervix result either from direct extension or from metastasis to the regional lymph nodes. Hematogenic bone metastases are uncommon. Roentgen examination is indispensable for the diagnosis of osseous lesions, and excellent palliative results are obtainable by moderate x-ray doses, generally 2000 to 4000 r, distributed to two or four fields, and, if necessary, repeated.

ERNST A. SCHMIDT, M.D.

The Scalenus Syndrome: Brachial Plexus Neuritis. E. M. Hammes. Minnesota Med. **23**: 377, May, 1940.

A unilateral brachial plexus syndrome of non-traumatic origin may be due to cervical rib, but may also occur without it. Metastatic involvement of the cervical vertebrae, hypertrophic arthritis of the spine, cervical hypertrophic pachymeningitis due to syphilis, syringomyelia, cord tumor, all may be etiologic factors. In the absence of cervical rib, the syndrome may be due to a congenital mal-relationship in the shoulder girdle. Embryologically a post-fixed brachial plexus is more readily subjected to tension and angulation in its course over the first rib and behind the scalenus anticus muscle. Factors causing the shoulder to droop may precipitate the syndrome.

PERCY J. DELANO, M.D.

Myositis Ossificans Traumatica. A Thorndike, Jr. J. Bone & Joint Surg. **22**: 315–323, 1940.

It is the contention of the author that myositis ossificans is really an inflammatory condition with all the clinical evidence of "tumor," "dolor," and "calor" present. Sections for microscopic examination are usually made in the late stages when the inflammatory reactions have long since disappeared and only ossification is present. Even at this stage sections have been diagnosed as osteogenic sarcoma.

The author believes that there is a definite "diathesis" and in its presence, only the inciting agent, trauma, is needed to produce the disease. The sequence is:

first, a deep-muscle contusion with tearing of muscle, capillaries, and periosteum; second, hemorrhage with accompanying inflammatory reaction and hematoma formation; third, hematoma absorption with subsequent ossification.

In the acute stage of myositis ossificans, bed rest, heat, and elevation of the part are advised. Ossification does not occur until between the second and third week. Massage is contraindicated, especially in the beginning. Operative removal should not be attempted until all inflammation has subsided, usually after a period of twelve to twenty-four months.

JOHN B. McANENY, M.D

RADIOTHERAPY

MALIGNANT NEOPLASMS

Irradiation Assailed, or the Buried Talent. E. Rock Carling. British Jour. Radiol. **13**: 73–81, March, 1940.

This paper is almost entirely an answer to criticisms of x-ray and radium therapy. The author evaluates the accomplishments of radiation therapy and compares these accomplishments with other methods of treatment.

In the middle section of the paper is a brief outline of the author's attitude regarding cancer of the breast. He believes in removing the primary lesion and lymph nodes from the axilla surgically, when possible. He advocates moderate pre-operative irradiation. He does not advise vigorous pre-operative irradiation because it makes surgery more difficult. He favors thorough post-operative irradiation.

SYDNEY J. HAWLEY, M.D.

Carcinoma of the Uterine Cervix: Results of Treatment through 1933, Showing Value of Supplementary X-radiation. G.V. Smith and F. A. Pemberton. New England J. Med. **222**: 481–493, March 21, 1940.

This report extends a series of cases of cervical carcinoma, previously reviewed, to the year 1933, inclusive. The series begins with cases dating from 1876, and now includes 997 patients, but for various reasons the number is reduced to 780 proved cases.

The five-year survival rate is seen to be increasing, with improvement of methods, from 12 to 38 per cent; the ten-year survival rate from 8 to 21 per cent. Operative mortality has decreased. The best five-year survival rate is obtained in the group receiving radium and x-ray therapy.

Clinical classification and pathological grading are considered practically useless in the evaluation of therapy. Indications for surgery are becoming more restricted. The incidence of carcinoma of the cervical stump was 5 per cent in the series recorded, which indicates the importance of removing the cervix when hysterectomy is done. Follow-up examination should include the whole urinary tract.

JOHN B. McANENY, M.D.

Control of Bone Metastases of Mammary Origin by Roentgen Therapy. Samuel Brown and Archie Fine. Jour. Med. **21**: 31, 32, March, 1940.

This is a case report of a 50-year-old patient who had had her left breast amputated for carcinoma of the scirrhous type, in 1932. In 1935, metastatic lesions developed in her ribs, spine, and pelvis. These were treated by irradiation, with complete relief of pain and calcification of many areas. Additional metastatic areas were later discovered and responded to irradiation. The patient was living comfortably in October, 1939.

JOHN B. McANENY, M.D.

NON-MALIGNANT CONDITIONS

Use of Roentgen Rays in the Treatment of Furuncles and Carbuncles. Ernst A. May. J. M. Soc. New Jersey **37**: 14–16, January, 1940.

This is a general discussion of radiotherapy in superficial inflammatory lesions. A brief historical résumé is followed by an enumeration of generally observed changes following low-voltage, low-intensity irradiation with heavy filtration. Exact factors are not given. The author stresses the importance of early treatment and is convinced of the uniformly good results.

Irradiation produces spontaneous resolution or early localization, requiring only a stab wound for adequate drainage. Within three to twelve hours after treatment there is an increase of pain and swelling followed by a rapid general improvement. The cosmetic result is invariably better than when surgery alone is employed. In furunculosis of the face radiotherapy is almost indispensable, having reduced the mortality from 15 to 3 per cent. In diabetics its use is likewise of great value. The fact that roentgen therapy is in most cases only an adjuvant to surgery must always be kept in mind.

MAX MASS, M.D.

Treatment of Large Hemangiomas. K. Lenggenhager. Schweiz. med. Wchnschr. **70**: 250–251, March 23, 1940.

Two cases are reported. In the first, an enormous hemangioma occupying the right cheek and upper part of the neck, in a girl seven months old, failed to respond

to magnesium wire insertions and to coagulation with the high-frequency current, the time spent on these forms of treatment being two years. Thereafter five sessions of radium therapy (needle insertions) were undertaken; each session lasted about four days and roughly 2,000 mg. hr. were given. After a total dose of 10,080 mg. hr. given over a period of five months, the tumor regressed, and two years later there was no recurrence. Scarring and depigmentation of the skin, thought to be due to the coagulation, were present.

The second patient, also a seven-months-old girl, had a growth in the neck proved by biopsy to be a lymphangioma. Five 4 mg. needles were inserted and left in place four days (1,920 mg. hr.); this was supplemented by radium capsules applied externally at 1 cm. for 2,880 mg. hr. Two months later 3,072 mg. hr. were given with needles, and six months after this 432 mg. hr. to the eyebrow and cheek. This treatment produced a very marked regression.

LEWIS G. JACOBS, M.D.

Negative Results of Irradiation Therapy of the Pylorus and Brunner's Gland Area in Patients with Polycythemia Vera. K. W. Stenstrom, P. H. Hallock, and C. J. Watson. Am. J. M. Sc. **199:** 646–650, May, 1940.

The interesting hypothesis has been advanced that in polycythemia vera the over-production of erythrocytes is due to an excessive elaboration of the antipernicious anemia principle (intrinsic factor of Castle). In line with this theory, Singer performed a gastrectomy in a patient with polycythemia who was also suffering from a duodenal ulcer. A year after the operation, the erythrocyte count was 4.6 million.

Following the lead of Andersen, Geill, and Samuelson, who achieved a good result, the authors irradiated the pylorus and duodenum of four patients. The total doses, delivered through anterior and posterior ports, ran from 2,200 to 2,800 r, with about 2,000 r delivered through the anterior portal. No therapeutic response was obtained.

BENJAMIN COPLEMAN M.D.

GENERAL

Use of Radioactive Isotypes as Tracers in Physiology: Letters to the Editor. H. R. Crane. Physical Rev. **56:** 1243, 1939. Lorin J. Mullins. Ibid. **56:** 1244, 1939. G. Hevesy. Ibid. **57:** 240, 1940.

1. (Crane): The question has been raised as to whether the radiation from a radio-active tracer may exert a disturbing influence upon the physiological process which is being studied. Argument is presented to show that it can only be the general radiation produced which may affect the process, not the radio-active disintegration of the particular atom that one is observing. It is ordinarily not necessary to use tracers producing a disturbingly high general radiation.

Concerning the ability of biological material to discriminate between the radio-active and non-radio-active isotypes in a given element, the difference in weight is unlikely to produce a perceptible effect, inasmuch as only for hydrogen is the difference between the weights of the isotypes very marked. It may also be pointed out that there are actually radio-active isomers, of the same weight, which would entirely eliminate the above question.

2. (Mullins): Few reports are available concerning the general systemic effect of radio-active isotypes. Mullins reports that for a unicellular alga 1 to 50 millicuries per liter of radioactive sodium will produce a decrease in the rate of uptake of sodium. Most work with radio-active isotypes, however, has employed lower intensities than this.

3. (Hevesy): It is important, when discussing the possible disturbing effects of the radiation, to envisage that the method of radio-active indicators is not based on atoms disintegrating and thus emitting radiation in the animal, but on the faculty of some of the atoms of

the indicator extracted from the tissues, for example, to emit radiation when placed under the Geiger counter. The number of disintegrating atoms inside the body must, of course, be kept low. In experiments on the permeability of the corpuscles to sodium, in the rabbit, the circulation was found to contain only one radio-sodium atom to a thousand blood corpuscles, and less than one-tenth of these atoms disintegrated in the circulation during the experiments.

R. R. NEWELL, M.D.

A Report on the Development of the Electron Supermicroscope at Toronto. A Letter to the Editor. E. F. Berton, J. Hilliar, and A. Prebus. Physical Rev. **56:** 1171, 1939.

The authors estimate that the resolving limit of their instrument at present is better than 60 Ångström units. Two figures show photomicrographs of colloidal gold with electron optical magnification of 12,700, total magnifications 45,000 and 180,000.

R. R. NEWELL, M.D.

Radioactive Standards. A Letter to the Editor from a Committee of the National Research Council, Robley D. Evans, Chairman. Physical Rev. **57:** 457, 1939.

The committee of the National Research Council on radio-active standards is preparing radium standards, dilute solutions of radium in 100 to 200 c.c. flasks, and also in 5 c.c. ampoules, the latter from 0.1 to 100.0 micrograms. They are also preparing thorium standards and standard rock samples.

R. R. NEWELL, M.D.

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